

challenge paper

POPULATION

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solving the world's challenges



Copenhagen Consensus 2012: Challenge Paper on “Population Growth”

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1. THE CHALLENGE OF “POPULATION GROWTH”

While the majority of the population is now estimated to live in regions with below replacement fertility, high fertility, poor reproductive health outcomes and relatively rapid population growth remain an important concern in several low income countries. International and national spending devoted to family planning, however, has declined significantly in recent years. Recent research has brought about a revision in the understanding of the interactions between population growth and economic development, as well as the effects of family planning programs in terms of reduced fertility, improved reproductive health outcomes and other life-cycle and intergenerational consequences. This paper discusses recent evidence about the benefits of family planning programs and the interactions between population growth and developments, and it attempts to estimate benefit-cost ratios for increased spending on family planning.¹

2. THE DEMOGRAPHIC TRANSITION: AN UNFINISHED SUCCESS STORY

The demographic transition in developing countries during the 2nd half to the 20th century is widely considered a “*success story*”. Between 1950–55 and 2005–10, the life expectancy in less developed countries² increased from 42.3 to 66 years (a total gain of 23.7 years, or an average annual gain of .43 years), and in the least developed countries, it increased from 37.2 to 56.9 (a total gain of 19.7 years, or an average annual gain of .37 years). Fertility rates declined from a total fertility rate (TFR) of about 6.1 in less developed countries in 1950–55 to 2.7 children per woman in 2005–10 (an annual decline of about 0.062), and TFR levels declined from 6.5 to 4.4 children per woman in the least developed countries dur-

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¹Following Bongaarts and Sinding (2011a), family planning is used to refer to programs that to provide information about contraception, as well as contraceptives themselves and related reproductive health services. Such programs do not generally include abortion, and consensus statements produced by the UN explicitly exclude abortion as a method of family planning. However, in some countries where abortion is legal, it is offered alongside contraceptive information and services.

²Including least developed countries; the classification follows the UN Population Division grouping into more developed countries, less developed countries, and least developed countries; where less developed countries include—unless otherwise noted—the least developed countries; see <http://esa.un.org/unpd/wpp> for additional information.

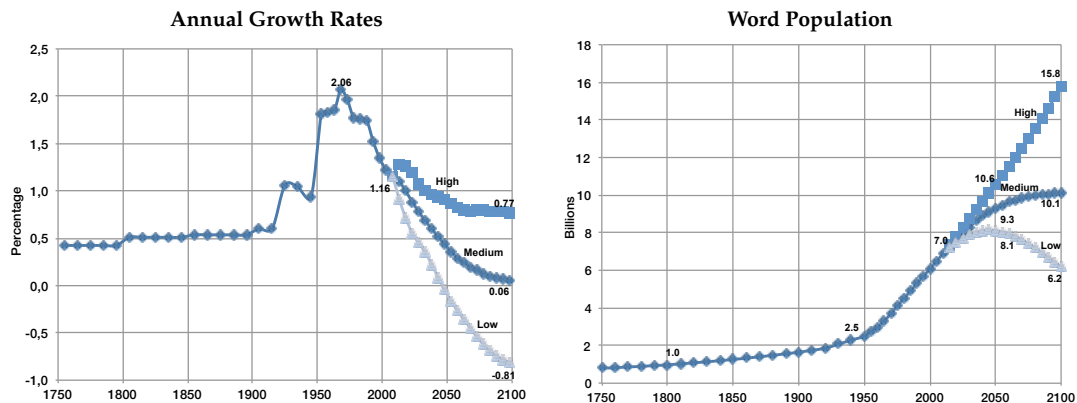


Figure 1: World population and annual growth rates of the world population according to different UN projection variants

Note: The low, medium and high scenarios assume the same mortality trends, and differ in the level of fertility. After 2010, the fertility levels in the different scenarios converge, and after 2015 the TFR in the high fertility scenario is .5 above that of the medium scenario, and in the low fertility scenario, the TFR is .5 below that of the medium scenario. In the medium scenario, global TFR declines from 2.52 (2010) to 2.03 in 2100.

Source: Global Agenda Council on Population Growth (2012), based on UN Population Division (2010c)

ing this time period (an annual decline of about 0.038). Global annual population growth rates declined from a peak of 2.07% in 1965–70 to 1.16% in 2005–10 (Figure 1). The growth rate in less developed countries also peaked during 1965–70 at about 2.5% per year, while growth rates in the least developed countries peaked during 1990–95 at 2.75%. By 2005–10, the growth rates declined to 1.33% and 2.21% respectively. The majority of the world population is now estimated to live in regions with below replacement fertility ($TFR \leq 2.1$) (Wilson 2004), and the global TFR is projected to reach 2.1—the conventional, albeit globally not necessarily correct marker for replacement level fertility (Espenshade et al. 2003; Kohler and Ortega 2002)—by 2070 (UN median projection; UN Population Division 2010c). As a result of the increases in life expectancy and reductions in fertility, in many developed countries—and increasingly also in some developing countries—concerns about very low fertility and rapid population aging have emerged as important demographic concerns (Kohler et al. 2002; Lee 2011), and some scholars have postulated that shrinking families are “the new population problem” (Crouter and Booth 2005).

In less developed countries, rapid declines of mortality and fertility have often been associated with rapid economic development. For example, in South Korea during 1950–2010, life expectancy increased from 47.9 to 80 years, fertility (TFR) declined from 5.1 to 1.3 children per woman, and GDP per capita grew substantially with a growth rate of more than 5% p.a. during 1960–2010. While often seen as a sufficient condition for fertility decline (Figure 2), however, rapid economic development is not always a necessary conditions: in Bangladesh during 1950–2010, for example, life expectancy increased from 45.3 to 67.8, fertility (TFR) declined from 6.4 to 2.4 children per woman, and GDP per capita grew during 1960–2010 at an average rate of only 1.5% p.a. Both India and China saw large fertility declines before the onset of rapid economic growth. Iran holds the record of the most rapid decline in fertility from 6.5 to 1.8 during the period 1980–2010 when Iran was a Islamic Republic and average economic growth was relatively modest at around 1.3% p.a (see also Abbasi-Shavazi et al. 2009a,b). During these diverse patterns of demographic transitions that unfolded during the 2nd half of the 20th century, the world population grew rapidly (Figure 1). The World population doubled from 1.5 to 3 billions in between

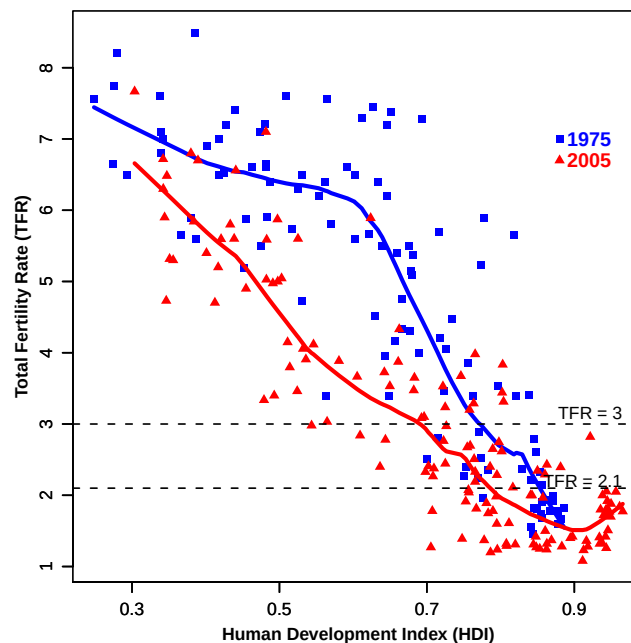


Figure 2: Cross-sectional relationship between the total fertility rate (TFR) and the human development index (HDI) in 1975 and 2005

Note: The HDI is the primary index used by the United Nations Development Programme (UNDP) to monitor and evaluate broadly-defined human development, combining with equal weight indicators of a country's health conditions, living standard and human capital. The HDI in this figure is recalculated using a time-invariant formula so that it is longitudinally comparable between 1975–2005 (for a discussion, see Myrskylä et al. 2009). There is a clear negative association in 1975 and 2005 between the level of human development (as measured by the HDI) and the level of the total fertility rate, with a possible reversal of this correlation occurring in 2005 for the most developed countries. In addition, there is important the heterogeneity in the 2005 fertility rates at the various development stages. On the one hand, low fertility in 2005 is no longer restricted to the most developed countries: TFR levels of below 2.1 are achieved at 2005 HDI levels as low as .7, and TFR levels of below 3.0 are attained by countries at 2005 Human Development Index (HDI) levels of .55. On the other hand, fertility levels vary widely for all but the highest levels of development. For example, countries with a 2005 HDI of .4–.6 exhibit TFR levels ranging from 3 to 7.1 (mean is 4.7), and TFR levels range from 1.2 to 5.9 among countries with a 2005 HDI of .6–.8 (mean TFR is 2.6).

Source: Adapted from Myrskylä et al. (2009) and Kohler (2010)

the late 19th century and 1960, and it doubled again from 3 to 6 during 1960–99. The year 2011 marks the year when the world population has reached 7 billion persons, adding the last 7th billion in merely 12 years—not unlike the time periods it took to add the 5th and 6th billion to the world population.³ However, despite the rapid population growth during the last decades, the prominent doomsday prediction from the 1960s and 1970s about the potentially disastrous consequences of rapid population growth did not materialize. Not only did the world avoid the prominent predictions of major food crises and environmental degradation made in books such as *“The Population Bomb”* or *“The Population Explosion”* (Ehrlich 1968; Ehrlich and Ehrlich 1990), but various measures of individual well-being increased globally—including both in both more developed and less developed countries: despite rapid population growth during 1960–2010 (Figure 1), global GDP per capita grew from \$2,376 to \$5,997 (in constant 2000 US\$) (+152%), life expectancy has increased from 51.2 to 67.9 years (+33%), infant and maternal death rates have declined substantially, level

³According to UN population estimates, the UN estimated that the world population reached 3 billions on 20 October 1959, 4 billions on 27 June 1974, 5 billions on 21 January 1987, 6 billion on 5 December 1998, and 7 Billions on 31 October 2011 (see http://esa.un.org/wpp/Other-Information/pr_faq.htm); the time it took to add 4th, 5th, 6th and 7th billion is therefore 14.7, 12.6, 11.9, and 12.9 years respectively.

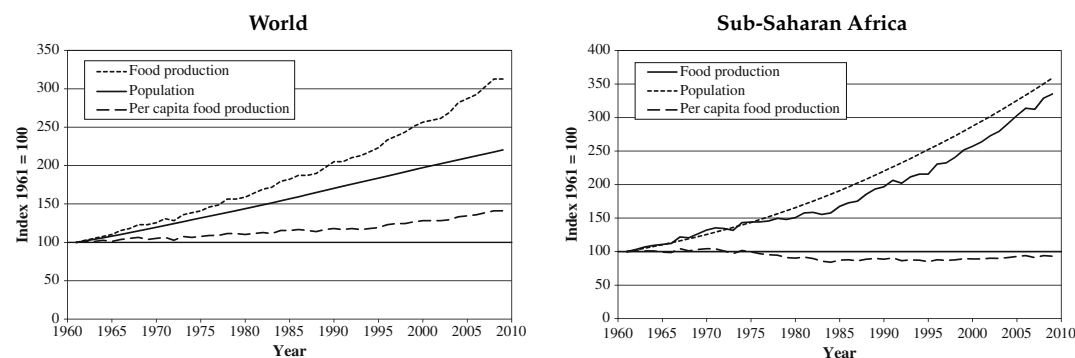


Figure 3: Food production, globally and in sub-Saharan Africa, 1961–2009

Source: Lam (2011), based on data from FAO (2011)

of education—and importantly also levels of female schooling—have increased, global per capita food production and consumption have risen, and the proportion of the global population living in poverty has declined significantly (Lam 2011) (Figure 3).

Lam (2011) recently attributed this accomplishment of increasing well-being despite rapid population growth—which was taken far-from-granted several decades ago—to the combined effect of six factors, three of which are economic, three demographic (Lam 2011): (1) *market responses*, causing for instance farmers to grow more food in response to higher food prices or causing individuals to substitute away from scarce resources whose prices increase in response to population pressures; (2) *innovation*, where population growth increases the incentives (and potentially also the abilities) to develop new technologies and knowledge, such as those underlying the green revolution, that use available resources more efficiently; (3) *globalization*, having resulted in an increased economic integration of countries through international flows of good and capitals that improved efficiency of both production and distribution; (4) *urbanization*, in which cities have absorbed a significant proportion of the population growth in recent decades, thereby contributing to innovations, economic growth and improvements in efficiency that helped to achieve increases in living standards despite growing populations;⁴ (5) *fertility decline*, causing birth rates with some lag to follow declining mortality rates and reducing rates of population growth (Figure 1); (6) *investments in children and child quality*, resulting in large increases school enrollment and human capital (for males, and even more so, for females), despite rapidly growing cohort sizes, that contributed to reduced fertility, improved own and child health, increased productivities and economic growth.

Chances are, the recent decades will remain a unique period in global demographic history: after attaining a doubling of the world population most recently in only 39 years from 3 to 6 billions, the global population is unlikely to double again. In the UN medium projection, the global population will level off at around 10.1 billions in 2100, and even in the high fertility scenario, the global population will remain below 16 billions. Estimates of the earth's carrying capacity are of little help in assessing if this growth is sustainable and/or compatible with maintaining or even improving living standards (Cohen 1995a,b). And while adding another 3 billion persons to the global population without undermining past progress in global living standards or measures of well being—or perhaps even

⁴Some scholars argue that urbanization in sub-Saharan Africa is occurring significantly slower as often believed. For example, according to Potts (2012a,b), very few countries in SSA have been experiencing rapid urbanization, in part because *both* urban and rural populations are growing rapidly. According to Pott's analyses, many countries in SSA are urbanizing very slowly, and some have even de-urbanized.

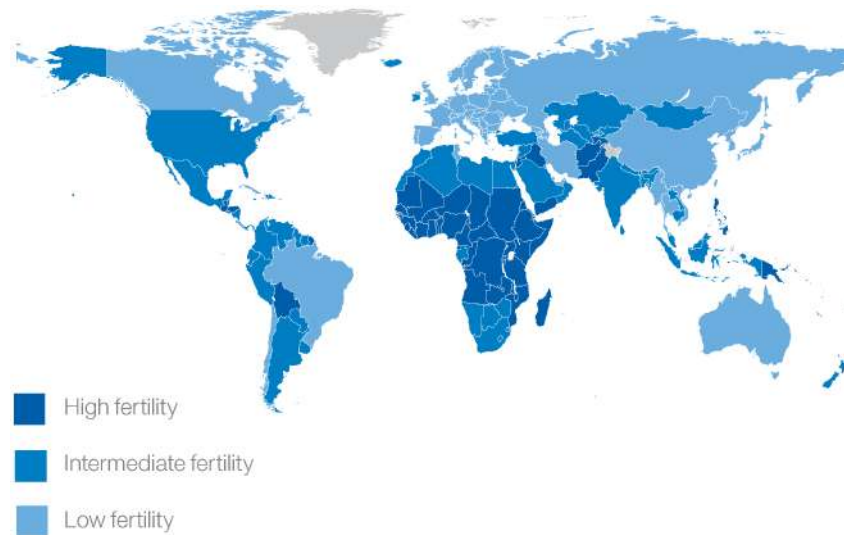


Figure 4: Countries according to fertility level 2005–10

Note: Low fertility countries: net reproduction rate (NRR measured in daughters born per woman) less than 1; intermediate fertility countries: NRR between 1 and 1.5; high fertility countries: NRR above 1.5

Source: Global Agenda Council on Population Growth (2012), based on UN Population Division (2010c)

improving upon them—will remain a challenging task, the tone of the population debate and the perceived urgency of “the population problem” has dramatically changed in recent years. The *Economist* for example feature major articles with titles such as “Go forth and multiply a lot less: Lower fertility is changing the world for the better” (The Economist 2009) and “The world’s population will reach 7 billion at the end of October [2011]. Don’t panic” (The Economist 2011a), and while continued challenges of accommodating population growth remain, the most recent press coverage of 7th billion persons living on earth (e.g., National Geographic Magazine 2011; Osotimehin 2011; Roberts 2011; The Economist 2011a,b,c) has been a lot less alarmist than in earlier discussions that echoed the fears expressed in books like “*The Population Bomb*” (for a analyses of earlier population discussion of the population problem, see Wilmoth and Ball 1992). A possible reason for this shift in perceptions of the population problem is that, in many developing countries, as a result of substantial fertility declines any future population growth is much more driven by population momentum—i.e., expected increases in the number of individuals at primary reproductive ages in the next decades that result from young age distributions and high previous rates of population growth—rather than high current or future levels of fertility for which family planning programs might provide one possibly policy intervention.

And yet, despite the undoubted successes of global mortality and fertility declines, and the resulting recent declines in the rate of global population growth, the demographic transition remains an *unfinished success story*. High fertility and rapid population growth remain important concerns in many least developed countries that may be most vulnerable to the consequences of population growth (Figure 4). For example, because fertility declines in SSA during recent years were less rapid than previously expected earlier (Bongaarts 2008; Ezeh et al. 2009; Garenne 2011), the UN unexpectedly revised its 2010 forecast for the world population upward to 10 billions, as compared to earlier forecasts predicting a leveling off at 9 billions (UN Population Division 2010c). A recent report prepared for the 2012 World Economic Forum (Global Agenda Council on Population Growth 2012), for example, identifies 58 high fertility countries, defined as countries with net reproduc-

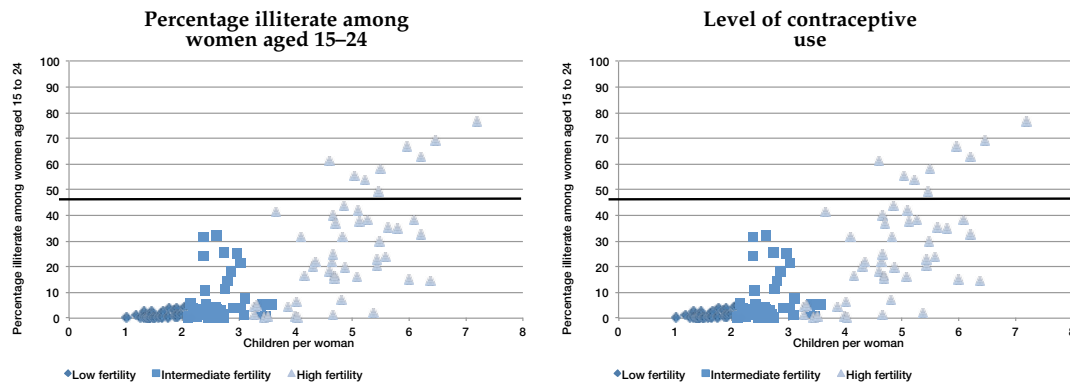


Figure 5: Percentage illiterate among women aged 15–24 and most recent level of contraceptive use, by TFR levels

Source: Global Agenda Council on Population Growth (2012), based on UN Population Division (2011), UN Statistics Division (2011) and UN Population Division (2010c)

tion rates (NRR) of more than 1.5 (Figure 4) that have intrinsic population growth rates of 1.4% or higher.⁵ The high fertility countries are concentrated in Africa, where 39 out of the 55 countries on the continent have high fertility, but also exist in Asia (9 countries), Oceania (6 countries) and Latin America (4 countries). Almost two third of these high fertility countries are classified by the United Nations as least developed, and 38 out of the total of 48 countries that are classified as least developed have high fertility. Most high fertility countries have current population growth rates of 2.5 percent or higher, which, if maintained, would imply a doubling of the population every 35 years. Female education levels (as indicated by illiteracy) and contraceptive use tend to be relatively low in the high fertility countries (Figure 5). Despite having currently only about 18% of the world population, high fertility countries account today for about 38% of the 78 million persons that are added annually to the world population. Based on UN median population projections, the TFR in high fertility countries is projected to decline to 2.8 by 2050, and 2.1 by 2100. Despite these projected TFR declines, the current high fertility countries will make the largest contribution to the annual increment of the world population after 2018, and after 2060, world population is projected to grow exclusively as a result of population growth in the current high fertility countries (Figure 6). During the 21st century, therefore, the current high fertility countries will be the major contributors to continued world population growth. Past and continued progress in reducing mortality, combined with sustained above-replacement fertility levels that does not drop to a TFR of 2.1 until 2100 in the UN median projection, will be a primary cause of this rapid population growth, *in addition to* a population momentum that results from the very young age structures in these countries.

The analyses in this paper will primarily focus on high fertility countries in sub-Saharan Africa (SSA) because this region has the highest concentration of high fertility countries that make the dominant contribution to the world population growth resulting from high fertility countries (Figure 4), and because SSA high fertility countries belong to the poorest and most vulnerable countries in the world with often weak institutions and capacities to manage population growth. Figure 7 shows the observed and projected (based on UN sce-

⁵ A net reproduction rates (NRR) of more than 1.5 means that more than 1.5 daughters are born to women given 2010 fertility and mortality levels. This implies that the next generation is 50% larger than the current generation, and at constant fertility and mortality levels, a NRR of 1.5 implies a long-term annual population growth rate of about 1.4%. Intrinsic growth rate is the population growth rate that would prevail in the long term if current patterns of fertility and mortality were to prevail in a population and the population is closed to migration.

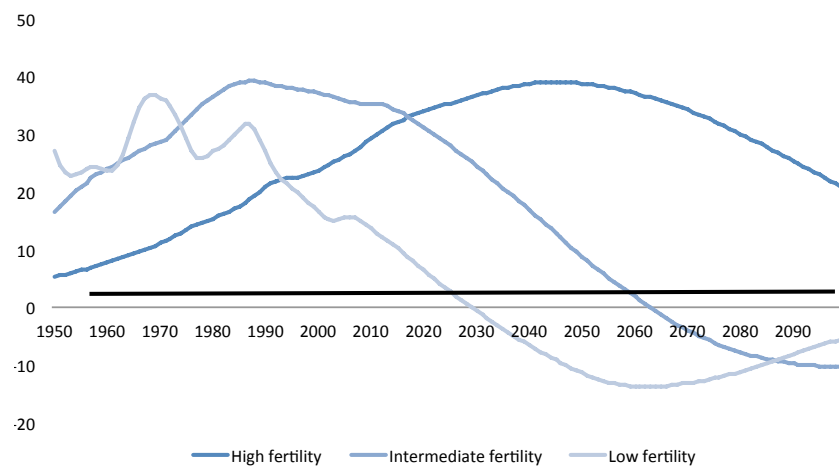


Figure 6: Annual increments of the population in high-fertility countries, intermediate-fertility countries and low-fertility countries according to the medium projection variant, 1950-2100 (millions)

Source: Global Agenda Council on Population Growth (2012), based on UN Population Division (2010c)

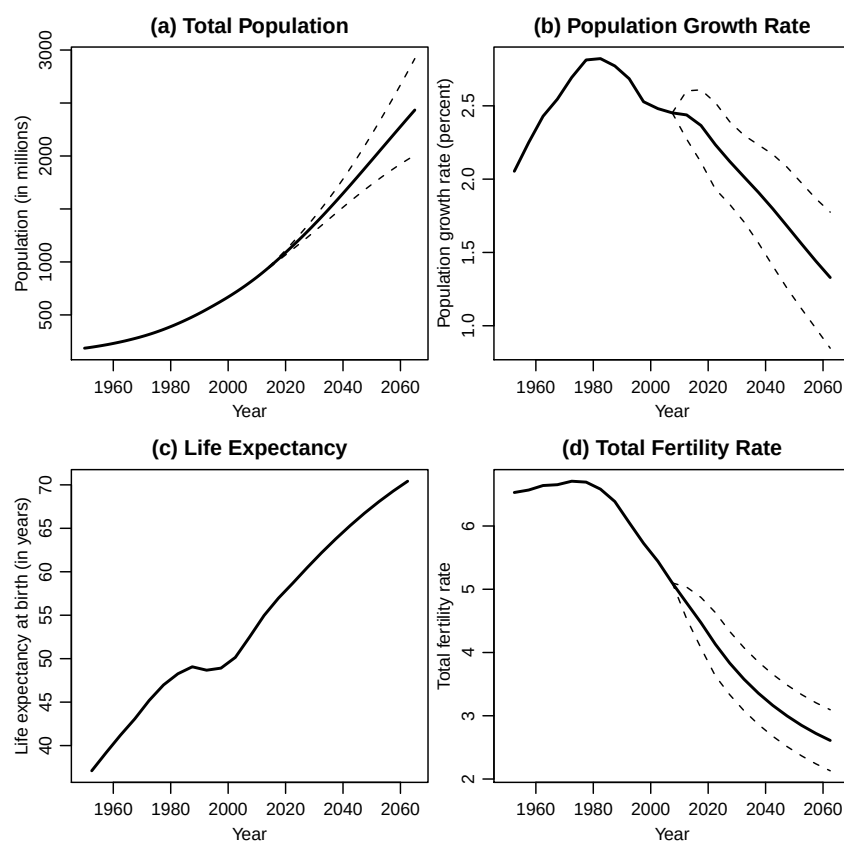


Figure 7: Population size, population growth rate, life expectancy at birth and total fertility rate for Sub-Saharan Africa, 1950-2060

Note: Based on UN median, high and low projections (UN Population Division 2010c). Bold line: median projection. Broken lines: low/high projections. Projected life expectancy is identical across the UN medium, low and high projections.

Table 1: Population size, total fertility rate (TFR), life expectancy and population growth rate in the 10 most populous SSA countries

Source: Based on UN median projections (UN Population Division 2010c)

	Population (millions)		TFR		Life Expectancy at birth		Growth Rate (in percent)	
	1980	2010	1980–85	2005–10	1980–85	2005–10	1980–85	2005–10
Nigeria	75.5	158.4	6.8	5.6	45.8	50.3	2.55	2.50
Ethiopia	35.4	82.9	6.9	4.6	43.5	57.2	2.96	2.21
DR Congo	27.0	66.0	6.7	6.1	46.2	47.4	2.78	2.78
South Africa	29.1	50.1	4.6	2.6	58.4	51.2	2.52	0.96
Tanzania	18.7	44.8	6.6	5.6	50.8	55.4	3.13	2.88
Sudan	20.1	43.6	6.3	4.6	50.2	60.3	3.19	2.51
Kenya	16.3	40.5	7.2	4.8	58.9	55.0	3.78	2.58
Uganda	12.7	33.4	7.1	6.4	49.9	52.2	3.12	3.24
Ghana	10.9	24.4	6.3	4.3	53.8	62.7	3.28	2.39
Mozambique	12.1	23.4	6.4	5.1	42.8	48.8	1.87	2.38

narios) population size, population growth rate, life expectancy at birth and total fertility rate for the period 1950–2060. The overall SSA population growth rate has peaked in the early 1980s and has been declining from its peak of 2.8% in 1980–85 to 2.5% in 2005–10. It is 110% higher than the global population growth rate, resulting in both a projected rapid growth of the population as well as an increasing share of the global population that is in SSA. While mortality has declined, and life expectancy has increased significantly in SSA, the progress has lagged behind other developing countries, in part but not only, due to the HIV/AIDS epidemic (Magadi and Agwanda 2010). For example, the 2005–10 life expectancy of 52.5 years is 20% below the average life expectancy in less developed countries; infant mortality in SSA is 85 per 1,000, 68% higher than the infant mortality rate in all less developed countries, and the maternal mortality of 640 per 100,000 live births (2008) exceeds that of all less developed countries by 120% (UN Millennium Development Goals 2011; UN Population Division 2010c). And while fertility has declined from its peak of 6.71 in 1970–75, the 2005–10 TFR levels for SSA of 5.1 exceed that of all less developed countries by 90%. And because more than 42% of the SSA population is below age 15 in 2010, there is considerable population momentum even if fertility were to decline relatively rapidly.

It is important to emphasize that these averages mask considerable heterogeneity in both fertility and mortality (Table 1), with TFR among the 10 most populous SSA countries ranging from 2.6 to 6.1, and life expectancy ranging from 48.8 to 62.7. On the one hand, several of these largest SSA countries have experienced substantial declines in fertility. But, on the other hands, these sustained declines in fertility are far from universal in SSA, and many SSA countries continue to have high fertility and rapid population growth rates. The potential implications of this are also increasingly recognized by political leaders. While in 1976 just 38 per cent of the governments of countries in Africa viewed fertility as *too high*, 75 per cent of them did so by 2009; 68% considered the rate of growth of the population as too high as compared to 35% in 1976 (UN Population Division 2010a).

To illustrate the rapid projected population growth in some SSA countries, Table 2 lists nine countries whose population is expected to *triple* between 2010 and 2060 base on the UN medium population projections along with their 2010 and 2060 population size and projected growth rates. The population growth rate in these countries is the next five decades ranges from 2.2–3.0 percent, is therefore expected to be 14–55% higher than the projected SSA average. The relatively high fertility underlying this projected rapid population growth is often attributed to the fact that many high-fertility SSA countries have a considerable—and possibly growing—“*unmet need*” for family planning, where unmet

Table 2: SSA countries that are projected to triple their population size during 2010–60

Source: Based on UN median projections (UN Population Division 2010c)

	Population Size (in millions)		Ratio 2060 to 2010 population	Projected population growth rate 2010–60
	2010	2060		
Niger	15.5	70.9	4.57	3.04
Zambia	13.1	59.2	4.52	3.02
Malawi	14.9	63.3	4.25	2.89
Somalia	9.3	36.0	3.85	2.70
Tanzania	44.8	172.2	3.84	2.69
Burkina Faso	16.5	56.8	3.45	2.48
Uganda	33.4	112.6	3.37	2.43
Mali	15.4	50.5	3.29	2.38
Madagascar	20.7	63.2	3.05	2.23
SSA	856.3	2277.3	2.66	1.96

need is a concept used by demographers to measure the number of women who are fecund and sexually active, but are not using any method of contraception despite the fact that they report not wanting any more children or wanting to delay the next child (Casterline and Sinding 2000; UN Statistics Division 2011). The concept of unmet need thus points to a potential gap between women's reproductive intentions and their contraceptive behavior.⁶ In high fertility SSA countries, several studies indicate that a sizable fraction—around 25%—of sexually active fecund women who would like to limit their fertility do not use family planning methods and thus have unmet need for family planning (Darroch and Singh 2011; Prata 2009; UN Population Division 2009). Moreover, given the relatively low rates of contraceptive prevalence and weak institutional support of family planning programs, and the significant changes necessary to achieve the fertility decline in the UN median scenario, some scholars consider the UN median scenario as too optimistic in terms of the assumed pace of future fertility decline (Cleland et al. 2011; Eastwood and Lipton 2011) because contraceptive use is unlikely to increase sufficiently fast to achieve these projected TFR declines. Moreover, while global food production has more than kept up with population growth since the 1960 (Figure 3), sub-Saharan Africa exhibits signs of strain. While feed production increased during 1960–2009 by a factor of 3.4—more than for the world as a whole—the population grew even faster (by a factor of 3.6) in that time period, causing per capita food consumption to decline by about 7% since 1961 (Lam 2011).⁷

In light of the above trends, a new literature is emerging that emphasizes the “*return of population growth factor*” (Campbell et al. 2007), the “*unfinished agenda*” of family planning programs (Cleland et al. 2006) or the “*stalls in fertility declines*” (Bongaarts 2006, 2008;

⁶Unmet need has been incorporated into the Millennium Development Goals (MDG) monitoring, where unmet need is expressed as a percentage of women married and in union aged 15 to 49 (UN Statistics Division 2011, Millennium Development Goals Indicators metadata). Critics of the concept of unmet need point out that this concept implies either a very broad or a very paternalistic notion of “*need*” (Pritchett 1994) because it includes not only women who want to use contraception and don't do so because of supply-side restrictions, but also identifies women as “*needing*” if they require additional motivation before they want to use family planning or are constrained by other than supply-side factors in their contraceptive decision-making; there are hence concerns that unmet need potentially overstates the potential effect of improved contraceptive provision, which modern family planning programs try to address by including also other reproductive health services, behavioral change communication and interpersonal communication through health workers and community leaders; see Section 3.4. For a comprehensive discussion of unmet need and its use in discussions of family planning and population policies, see Casterline and Sinding (2000).

⁷Lam (2011) also points out that the more recent trend is somewhat more encouraging, given that food production has grown faster than population since about 1995, although not fast enough to completely offset the earlier declines in per capita food production.

Ezeh et al. 2009) in SSA. Some analyses have speculated about a “*gift of dying*” in which the HIV/AIDS epidemic enhances the future per capita consumption possibilities of the South African economy by reducing fertility, thereby more than compensating for the loss of human capital (Young 2005). Yet, it is far from clear if such a negative effect of the HIV/AIDS epidemic on fertility exists (Fortson 2009; Kalemli-Ozcan and Turan 2011), in which case Young’s (2005) argument unravels. And yet, the HIV/AIDS epidemic is not central to the renewed concerns about population growth in SSA since its effect—especially given also the recent expansion of antiretroviral treatment (ART)—on overall population growth trends is relatively modest (UN Population Division 2010b). Focusing on fertility, therefore, a recent *Lancet* article Cleland et al. (2006) asked “*Can disaster be prevented in Niger?*”, given Niger’s unchanged TFR levels that are among the highest in the world, and “[*Is the*] *Kenyan success in jeopardy*”, given a stalling of the fertility decline in the last decade that has caused the UN to revise its median 2050 population projection for Kenya from 44 millions (2002 World Population Prospects) to 96.9 millions (2010 World Population Prospects). Potts et al. (2011) write in an article entitled “*Niger: Too little, too late*” that “*the failure to emphasize family planning since 1994 has transformed a serious demographic scenario into a potentially catastrophic one*”. Campbell (2007) described the silence around population growth as the “*perfect storm*” that may undermine broader development efforts. Just before the Copenhagen Consensus 2012 conference, a theme on population growth in sub-Saharan Africa in the New York Times included a slide show entitled “*In Nigeria, a Preview of an Overcrowded Planet*” and raised concerns about whether patterns of fertility decline, which have occurred elsewhere in the world and curtailed population growth, will similarly “*defuse the population bomb in sub-Saharan Africa [...] where the population rise far outstrips economic expansion*” (Rosenthal 2012a,b).

Continued high fertility, such as in Niger or Nigeria, or stalls in fertility declines during the last decade, such as in Kenya, are often attributed to a reduced pace (or lack of) economic development, continued high levels of desired fertility, relatively low levels of contraceptive use (possibly as a result of reduced and/or inadequate resources devoted to family planning programs), and relatively high levels of mortality (in part, but not only, as a result of the HIV/AIDS epidemic) (Bongaarts 2006, 2008, 2011; Cleland et al. 2011; Ezeh et al. 2009). Many of these analyses call for a renewed emphasis on family planning programs. However, to highlight the potentially broad benefits of reduced fertility and population growth, the contemporary literature arguing for a renewed interest in family planning programs does not view population growth a “*problem*” in itself, but portrays it as a major threat towards attaining social and economic development, such as for instance reflected in the Millennium Development Goals (APPG 2007; Cates et al. 2010; Cleland et al. 2006). Specifically, potential adverse effects that are often attributed to rapid population growth include poor health among women and children, slow economic growth and poverty, overcrowded schools and clinics and an overburdened infrastructure, as well as the depletion of environmental resources (Birdsall et al. 2001). There are also arguments that rapid population growth contributes to high unemployment and inequality among rapidly growing young populations may contribute to the spread of political violence and civil strife (Cincotta et al. 2003; Goldstone et al. 2012). A recent UK parliamentary report for example cites the United Nations Office of the High Representative for the Least Developed Countries as “*The battle against endemic poverty and chronic hunger, particularly in the world’s 50 Least Developed Countries, is made all the more difficult due to their current high rates of population growth*” and concludes that “*the [Millennium Development Goals (MDGs)] are difficult or impossible to achieve with current levels of population growth in the least developed countries*” (APPG 2007). Melinda Gates argued at the 2012 TED Summit “*Let’s put birth control back on*

the agenda" (Gates 2012b), based on the premise that many of the world's pressing social change issues depend on ensuring that women are able to control their rate of having kids. In similar vein, Campbell et al. (2007) writes in a recent *Science Policy Forum*: "*Decisions made now can influence the growth rate [through lowering fertility]. If the rates are not altered, hundreds of millions of families will suffer from poverty, hunger, inadequate education, and lack of employment opportunities, all of which might otherwise have been avoided.*"

And yet, despite the rapid population growth and the renewed concerns about social and economic development that are associated with it, resources devoted to family planning have waned. And while several major foundations—including the Bill & Melinda Gates Foundation and the Hewlett Foundation—have implemented major programs in the area of family planning and are drawing attention to family planning and related needs to invest in reproductive health in developing countries (Gates 2012a; Hewlett Foundation 2012), overall global resources spent on family planning have declined. For example, while funds committed by donors and developing countries to HIV and AIDS increased by nearly 300%, funds devoted to family planning declined by some 30% (Bongaarts 2008). In particular, donor funding for family planning peaked in 2002 at US\$ 700 million and has since declined to about US\$ 400 million (UNFPA 2010). Given the increase in the number of women of reproductive age, donor funding for family planning per capita has declined by more than 50% since 1995 in virtually all recipient countries. This relative neglect of family-planning programs is related to arguably due to premature claims of an end to the "*population explosion*," shifting attention from population growth to the AIDS epidemic and a consequent reallocation of resources, and growing conservative religious and political opposition (Bongaarts and Sinding 2011a). These cuts in donor funding are likely to have also contributed to a reduced commitment of developing country governments to family planning programs and a reduced availability of family planning services today as compared to a decade ago (Bongaarts and Sinding 2009). Evaluating progress—or lack thereof—in family planning efforts during the recent years, the above-cited UK parliamentary report write that the "*The Dream of Cairo*" (referring to the 1994 United Nations International Conference on Population and Development (ICPD) in Cairo) has failed and that the time since has been a "*Lost Decade*" for the focus on population and family planning (APPG 2007).

In light of this mismatch between declining funding of family planning programs and reduced international focus on issues related to population growth on the one hand, and the prospect of substantial population growth of some of the world's poorest and most vulnerable populations on the other hand, several scholars have called for a renewed investment in family planning programs, and a reinstatement of these programs as a priority in high fertility countries, to not only reduce population growth, but also facilitate the achievement of the Millennium Development Goals (APPG 2007; Cates et al. 2010; Cleland et al. 2006, 2012). Consistent with this new emphasis on family planning as part of a broader development agenda, the World Bank (2010) has issued a "*Reproductive Health Action Plan* that emphasizes reproductive health as a "*key facet of human development*" and argues that this renewed emphasis on reproductive health offers "*an unprecedented opportunity to redress the neglect of the previous decade*". And while the tide of the debate might be shifting in the direction of renewed interest in family planning programs, important skepticism about these programs remains. These critical perspectives on the effectiveness of family planning programs potentially have contributed to the waning support—both financial and otherwise—of these programs. Critics and skeptics, for example, often claim that (Bongaarts and Sinding 2009): family planning programs have little or no effect on fertility levels or the pace of fertility decline (Connelly 2008; Pritchett 1994); these programs are no longer necessary since fertility declines are under way globally and will

continue to even in the absence of such programs (Bongaarts and Watkins 1996; Eberstadt 2006); family planning programs are not cost effective (Pritchett 1994); the linkage between reduced fertility and slower population growth and economic development is weak (National Research Council 1986); the reversal of mortality declines as a result of the HIV/AIDS epidemic have made family planning and reduced fertility less important and desirable (Mosher 2000); and that family planning programs have made women the instruments of population control policies, and at worst, have been coercive (Campbell and Bedford 2009; Mosher 2008).

The proponents of family planning programs emphasize that many of these criticisms of family planning programs are mistaken (e.g. Bongaarts and Sinding 2009). Moreover, and potentially more importantly, recent research on the interactions between population growth and economic developments (Bloom and Canning 2004; Bloom et al. 2007b, 2002, 1998) and careful evaluations of past family planning programs (Joshi 2011; Joshi and Schultz 2007; Mills et al. 2011; Schultz 2009) have strengthened the case that family planning programs are a good “investment” (Bongaarts and Sinding 2011b) that not only help to reduce fertility but also facilitate the attainment of a broad set of development goals such as reduced infant and maternal mortality, increases in schooling and gender equality, and reductions in poverty (Global Agenda Council on Population Growth 2012). But is this renewed emphasis on population growth and family planning justified given our knowledge about the effects of family planning programs and the current knowledge about the interrelations between population growth and economic development? This assessment paper Copenhagen Consensus 2012 project therefore revisits the current literature on population growth, the demographic transition and family planning programs, and provides benefit-cost ratios for investments in family planning programs.

3. THE CAUSES AND CONSEQUENCES OF THE DEMOGRAPHIC TRANSITION

Demographic transitions, including those still in process in the developing world, are frequently perceived as resulting from the economic and technological changes of the modern era that have led to economic development, mass communication, effective programs of public health, availability of contraceptive methods and related social changes. Before the start of the demographic transition, lives were short (around 30 years), survival at all stages of the life course was relatively uncertain, fertility rates were high (with TFRs around 5–7 children per woman), population growth was slow, and populations were relatively young (Figure 8). During the demographic transition, initially mortality and then fertility declines, resulting initially in an increase and then a decline in the population growth rate (Figure 8). In addition, the age structure of the population is transformed. Initially, the population grows “younger” as a result of a rapid increase of births and a decline of infant mortality; then, the population grows “older” as a result of smaller birth cohorts, increased longevity, and the aging of the earlier large cohorts. Towards the end of the demographic transition, population growth declines (and potentially ceases or becomes negative), fertility is low, life expectancy is high, with mortality risks being low to very low at young and adult ages and deaths concentrated at older ages, and the population age structure being relatively old (Lee 2003, 2011). In addition to population size and age structure, family structures, life courses, social and economic contexts are fundamentally transformed (Lee and Reher 2011), with important implications for social and economic development that may further facilitate the demographic transition (Figure 9)

The social context of fertility decisions in pre-transitional populations has varied tremendously over time and space. It changed with trends in culture, religious and political influ-

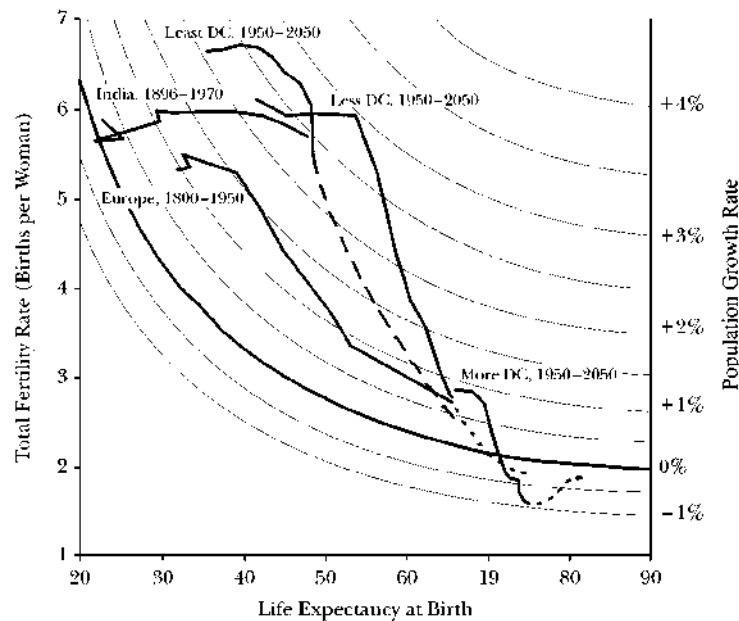


Figure 8: Life Expectancy and Total Fertility Rate with Population Growth Isoquants: Past and Projected Trajectories for More, Less and Least Developed Countries

Note: The horizontal axis of the figure shows life expectancy at birth. The vertical axis shows the total fertility rate. The contours illustrate the steady-state population growth rate corresponding to constant fertility and mortality at the indicated level, where the dark contour represents zero population growth and movement toward the upper right corner indicates increasingly rapid growth. On this graph, the demographic transition will first appear as a move to the right, representing a gain in life expectancy with little change in fertility and a movement to a higher population growth contour, then, as a diagonal downward movement toward the right reflecting the simultaneous decline in fertility and mortality, recrossing contours toward lower rates of growth.

Source: Lee (2003)

ences; it was affected by technological progress, innovations or discoveries; and it evolved through social and cultural adaptation. Despite these variations it is remarkable that population growth rates for most (surviving) societies were relatively modest over much of human history. Preceding the Neolithic Revolution (approximately 10,000 BC) the average long-run net reproduction rate was near unity, to within a few ten-thousandths. Between the Neolithic Revolution and 1750 AD the world population grew from 6 million to 771 million, which implies a very moderate average annual growth rate of 0.04%. Short-term fluctuations around this trend are well documented. Yet, the low long-term growth rates, that prevailed despite large variations in reproductive environments and mortality conditions, strongly suggest the existence of an equilibrating mechanism between population size and available resources: population homeostasis. This homeostatic theory was first devised by Malthus (1798) on the strength of three basic economic relationships he identified in pre-industrial England. On the one hand, when real wages fall below some subsistence level, mortality increases and population growth is curtained through a positive check of premature mortality. On the other hand, when real wages increase, marriage is encouraged. In addition, agricultural production faces diminishing returns to labor. Hence, increases in population size tend to imply lower wages, which in turn will tend to reduce population growth through positive checks (increased mortality) or preventive checks such as abstinence or delayed marriage. Demographic and economic evidence is largely consistent with the homeostatic theory for England from about 1250 to 1700 (Lee 1973, 1980). During this period, Wages were largely inversely related to population size. And despite the frequent

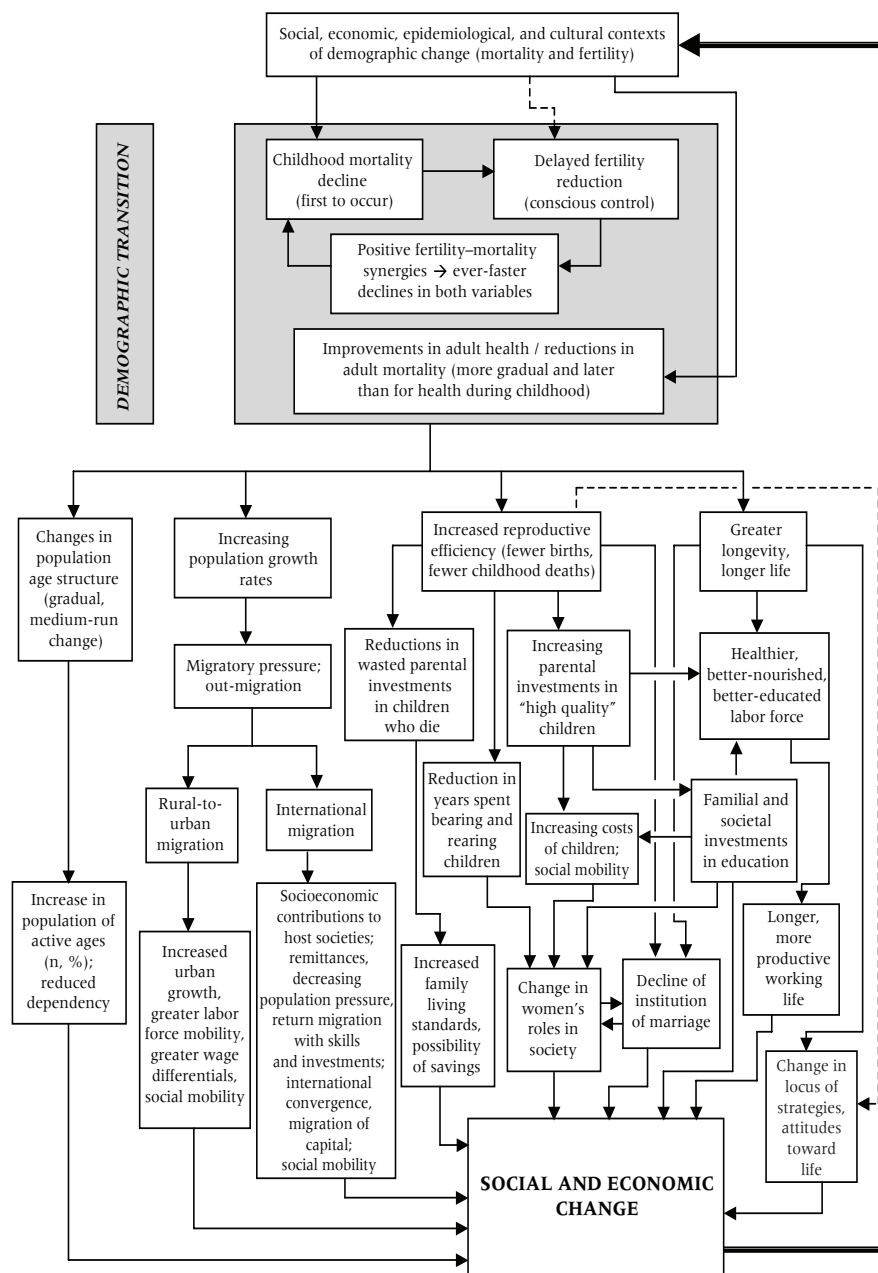


Figure 9: Schematic framework for the demographic transition and associated social and economic changes

Source: Reher (2011)

association of Malthusianism with a population re-balancing that occurs through increased mortality, even in preindustrial societies, the preventive check on population growth via fertility occupied a central place, whereas the positive check operated relatively independently of wage rates.

With the beginning of the Industrial Revolution in England these relationships unmistakably altered: population growth initially accelerated as a result of reduced mortality, but wages nonetheless continued to increase. With some delay, fertility started to decline, and so did population growth rates. The occurrence of rapid demographic change during the process of socioeconomic modernization led to the formalization of the *demographic transition theory*. The basic idea is that socioeconomic development first induces a mortality decline and, with some lag, a decrease in fertility. The easiest way to summarize this theory is to quote from one of its formulators:

[Premodern birthrates in Europe] ... were high by present standards. Indeed, they had to be high [in face of the inevitably high mortality]. ... Peasant societies in Europe, and almost universally throughout the world, are organized in ways that bring strong pressures on their members to reproduce. The economic organization of relatively self-sufficient agrarian communities turns almost wholly about the family, and the perpetuation of the family is the main guarantee of support and elemental security. ... In such societies, moreover, there is scant opportunity for women to achieve either economic support or personal prestige outside the roles of wife and mother, and women's economic functions are organized in ways that are compatible with continuous childbearing.

These arrangements, which stood the test of experience through-out the centuries of high mortality, are strongly supported by popular beliefs, formalized in religious doctrine, and enforced by community sanctions. They are deeply woven into the social fabric and are slow to change. Mortality dropped rather promptly in response to external changes because mankind had always coveted health. The decline of fertility, however, awaited the gradual obsolescence of age-old social and economic institutions and the emergence of a new ideal in matters of family size.

The new ideal of the small family arose typically in the urban industrial society. ... Urban life stripped the family of many functions in production, consumption, recreation, and education. In factory employment the individual stood on his own accomplishments. The new mobility of young people and the anonymity of city life reduced the pressures toward traditional behavior exerted by the family and community. ... Education and a rational point of view became increasingly important. As a consequence the cost of child-rearing grew and the possibilities for economic contributions by children declined. Falling death-rates at once increased the size of the family to be supported and lowered the inducements to have many births. Women, moreover, found new independence from household obligations and new economic roles less compatible with childbearing. ... Under these multiple pressures old ideals and beliefs began to weaken, and the new ideal of a small number of children gained strength. (Notestein 1953, pp. 16-17)

The corpus of this theory is very broad. It entails the central role of norms and their erosion, the emergence of rational fertility decisions, and the changing socioeconomic environment. As a descriptive tool, the theory provides a framework to conceptualize demographic change. The question is, how well the theory performs as a predictive tool that allows the analysis of fertility behavior in a positive sense, and that establishes a firm link between the causes and consequences of demographic change. Over the past few decades, intensive research on demographic change in historical and contemporary societies has

revealed complex patterns that do not fit neatly into the theoretical schema of the demographic transition, including for instance the stalled fertility transitions that have occurred in parts of SSA (Bongaarts 2006, 2008; Ezeh et al. 2009; Garenne 2011). The transition theory neglected the subtleties and variability of the process, and it became increasingly perceived as being too narrow in terms of the causal mechanisms and factors that are the primary drivers of mortality and fertility change. In particular, observing the fertility transitions during the 20th century, it is clear that fertility has declined in combination with rapid development, but it has also declined in resource poor countries (Vietnam, Bangladesh), in countries with low levels of female education (e.g., Haiti, Cambodia), in countries with low levels of female labor force participation (e.g., Egypt, Turkey) and in countries with high levels of gender inequality (e.g., Iran). And yet, the majority of fertility transitions in SSA are still in process, and in some areas a substantial decline in birth and population growth rates is yet to occur (Figure 4). Whether the fertility transitions in SSA will follow the pattern of earlier fertility transitions, for instance those in Latin America and Asia, remains the topic of a controversial debate. And so does the question of whether family planning programs, which may have contributed to the declines of fertility in other contexts, are effective—and possibly cost-effective—programs that can facilitate the decline of fertility and, as a consequences of better fertility control, improvements in health and economic development. To put the discussion of these issues into context, we first review in the next sections the knowledge about the causes of the demographic transitions, its implications for economic development, and the role that family planning may have played in facilitating fertility transitions.

3.1. Declines of Mortality

The decline in mortality is widely perceived to be a prerequisite of sustained fertility decline (Mason 1997), and population growth during the demographic transition arises due to lag between declining mortality and fertility rates (Figure 8). The decline of mortality therefore deserves some discussion in this paper, even if it is not the primary focus of the analyses here. In Europe, early declines in mortality during the 18th and 19th century were importantly driven by improvements in nutrition, sanitation, housing and transportation (Cutler et al. 2006; Lee 2003). Knowledge about the germ theory of disease were critical to changing both public health infrastructure and personal behavior. Public health measures played an important role starting in the late 19th century, and during the 20th century, medical progress in vaccination and the treatment of infectious and chronic diseases made important contributions to gains in life expectancy. The pace of gains in life expectancy has been remarkably constant, and Oeppen and Vaupel (2002) show that in the 160 years since 1840, life expectancy in the world's leading country in terms of longevity has increased by three months per calendar year. Improvements in life expectancy in developing countries occurred relatively rapidly compared to the historical gains in Europe. In India and China, for example, life expectancies have risen by nearly 30 years since 1950 and, even in Africa, where there has been much less economic progress, life expectancy rose by more than 13 years from the early 1950s to the late 1980s, before declining in the face of HIV/AIDS. Reniers et al. (2011) for instance finds that, declines in adult mortality in SSA during the last few decades have been modest, and in some populations drastic mortality reversals have been recorded. These reversals are primarily driven by the HIV/AIDS epidemic, but the extremely high adult mortality rates in some southeastern African countries are due to the triple burden of infectious and chronic diseases and the relatively high level of deaths due to external injuries.

The rapid decline in mortality after the World War II in developing countries happened

because knowledge and technologies based on 200 years worth of progress against mortality in the now-rich countries could be used in improving mortality in the rest of the world. Measures such as improvements in water supply, cleansing the environment of disease vectors (like anopheles mosquitoes that carry malaria or rats that carry lice), the use of antibiotics and the widespread immunization of children—the combined development of which had taken many years in the West—were introduced to the rest of the world over a relatively very short span of time. Preston (1980), for example, attributed about half of the gain in life expectancy in developing countries (excluding China) from the 1930s to the late 1960s to the combined effects of changes in income, literacy and the supply of calories, and the remaining to the public health measures newly implemented in these countries. And yet, there is a great deal more to be done before health in poor countries resembles that in rich countries today (Cutler et al. 2006). For many leading causes of death and/or poor health in the least developed countries, knowledge and technologies about suitable prevention and/or treatments are—at least in principle—relatively inexpensively available. These relatively easily preventable causes of death include for instance diarrheal disease and respiratory infections, being respectively the first and fourth leading causes of death worldwide, as well as malaria, tuberculosis and several infectious children's diseases such as whooping cough, tetanus, polio, diphtheria and measles. However, in many cases, these available and relatively cheap and easy-to-administer treatments and/or preventive steps continue to be used much less than seems desirable (and beneficial), and specifically in SSA, infant, maternal and adult mortality continue to remain relatively high (Rajaratnam et al. 2010; UN Millennium Development Goals 2011). Some related Copenhagen Consensus Assessment Papers have addressed some of the benefits and challenges in improving health and mortality through interventions (Behrman et al. 2004; Behrman and Kohler 2011; Hoddinott et al. 2012; Horton et al. 2009; Jamison et al. 2012, 2009; Jha et al. 2012). Efforts to improve health care systems and the utilization of existing technologies, knowledge and medications are actively promoted in many SSA and other developing countries. In addition, and specifically relevant for SSA, the recent roll-out of antiretroviral treatment for HIV/AIDS (UNAIDS 2010, 2011) has started to curtail and possibly reverse the increases in mortality that have occurred since the onset of the HIV/AIDS epidemic (Bongaarts et al. 2011; Herbst et al. 2009; Jahn et al. 2008). Reniers et al. (2011) finds that the onset of some of these recent declines in adult mortality even preceded the large-scale availability of antiretroviral therapy.

3.2. Why Fertility Declines

The fertility response to falling infant mortality was often remarkably fast (Mason 1997), frequently within one generation. Exploiting exogenous variation in the ecology of malaria transmission, McCord et al. (2010) for example estimate that in sub-Saharan Africa child mortality is a powerfully robust driver of fertility behavior, and that meeting the Millennium Development Goal of reducing 1990 child mortality rates by 66% in sub-Saharan Africa would translate into a reduction of total fertility rates from around 6.3 in 1990 to 3.3, more than halfway towards achieving replacement fertility levels of 2.1. The decline of mortality, which initiated the rapid growth of population during the demographic transition, therefore, also contributes to the end of population growth. And while mortality decline is almost always a precondition for sustained fertility decline, the link between patterns of mortality and fertility declines are not very tight (Guinnane 2011). For example, one of the central challenges to the notion of fertility change as formulated in the demographic transition theory is due to Coale (1973, p. 65), who concluded, based on analyses of fertility decline in Europe, that “[t]he diversity of circumstances under which marital fertility

has declined, and the consequent difficulties of formulating a well-defined threshold, may originate in the existence of more than one broad precondition for a decline". Coale thus identified three preconditions for a major fall in marital fertility: (i) fertility must be within the calculus of conscious choice; (ii) reduced fertility must be advantageous; (iii) effective techniques of fertility control must be available. These conditions are not so much a predictive tool as an integrative device for discussing the approaches of different behavioral schools. Demand theories, such as the economic approaches to fertility that are often referred to as the "*new home economics*" (Becker 1991; Willis 1973), have traditionally taken the first and third condition as granted, and analyzed fertility behavior as an adaptation to changing environmental conditions. Ideational and diffusion approaches (Cleland and Wilson 1987; Montgomery and Casterline 1993), on the other hand, emphasize the first and third factor. They interpret conscious fertility control within marriage as an innovation and focus on the diffusion or acceptance of this behavior. Supply theories (Easterlin and Crimmins 1985) emphasize the role of the third factor, the availability of methods to control fertility and the biological context of reproduction.

We focus in this review of fertility theories and the causes of fertility transitions primarily on the economic approach to fertility, which is usually associated with the *new home economics* initiated by Gary Becker (Becker 1991). The scope of the new economic approach to household behavior reaches far beyond fertility. At the same time, the demand for children and its interaction with related household decisions constitutes a central concern throughout the new home economics literature, and is an important question that continues to stimulate further empirical and theoretical developments. As currently employed, most household models for the demand for children share certain features (Schultz 1997). First, the traditional money income budget constraint is replaced by a time budget constraint, and considerable attention is devoted to the allocation of time between market labor supply and non-market activities, especially for women. Second, demographic and economic behaviors depend on the household stocks of human and physical capital, and differences across individuals in their relative advantages of engaging in specific market or non-market activities are an important determinant of a household's time allocation. Third, many models for the demand for children incorporate an explicit life-cycle perspective. Choices of individuals about human capital accumulation, marriage, saving, etc., are therefore considered as interrelated decisions that need to be investigated jointly.

In a simple and commonly used framework of the demand for children, parents are assumed to maximize lifetime utility, which depends for example on the number of children (*quantity* of children), the education and health of the children (often referred to as the *quality* of children), the leisure activities of the husband and wife, and other consumption goods. Each input into the utility function can be thought of as being produced within the home by combining both non-market time of the household members and market goods according to a constant returns to scale production function. Except for the integrated supply-demand framework by Easterlin and Crimmins (1985), the production function for children in the classic new home-economics models does usually not include limitations to the "*supply*" of children due to fecundity, mortality and child survival. The allocation of each individual's time is usually mutually exclusive and subject to an overall time budget constraint. Market income is equal to lifetime wage rate, received by each member of the family, times their market labor supply (plus additional non-labor income). The shadow prices of the above commodities are then defined as the opportunity costs of market goods and the household member's time inputs used to produce one unit of the commodity. In extension of this framework to overlapping generations models, parents exhibit intergenerational altruism and are concerned about the well-being of their children. This leads to

a dynastic utility function (Becker and Barro 1988; Galor and Weil 1996). The utility of the parents depends on the utility of its immediate offspring, and recursively on all future generations. The head of a dynastic family acts as if he maximizes the dynastic utility subject to a budget constraint that depends on the wealth inherited by the head, the cost of rearing children, and earnings in all future generations. Maximization of the resulting dynastic utility usually implies an arbitrage condition for consumption over generations, and it has important implications for intergenerational relations. According to this model, fertility, but not the growth of consumption per descendant, responds to variations in interest rates and the degree of altruism. More generally, fertility is also related to the growth in net costs between generations, and transfers to children depend on the taxes and production opportunities faced by children in the future (an assumption that has been questioned in more recent studies; e.g. Lee and Kramer 2002).

The optimal choice of children, consumption, as well as the optimal allocation of time and market goods to the various activities results in the above framework from utility maximization within the time and money income budget constraint and given prices and wages faced by the individuals in the household. Within this economic framework, fertility will also be influenced by how economic change influences the costs and benefits of childbearing, and investments in child quality will importantly be influenced by the returns to broadly defined human capital, which in part depends on mortality risks. Given the time intensity of bearing and rearing children, the opportunity costs of time are of particular relevance in determining fertility. For example, technological progress and increasing physical and human capital make labor more productive, raising the value of time in all activities, which makes children increasingly costly relative to consumption goods. Since women have had primary responsibility for childbearing and rearing, variations in the productivity of women have been particularly important. For example, physical capital may substitute for human strength, reducing or eliminating the productivity differential between male and female labor, and thus raising the opportunity cost of children. Rising incomes have shifted consumption demand toward non-agricultural goods and services, for which educated labor is a more important input. A rise in the return to education then leads to increased investments in education. Overall, these patterns have several effects: children become more expensive, their economic contributions are diminished by school time and educated parents have higher value of time, which raises the opportunity costs of childrearing. Furthermore, parents with higher incomes choose to devote more resources to each child, and since this raises the cost of each child, it also leads to fewer children (Becker 1991; Willis 1973). If parents wish to have a certain number of surviving children, rather than births per se, then once potential parents recognize an exogenous increase in child survival, fertility should decline. However, interactions between mortality and fertility are potentially important. For example, increased survival raises the return on postbirth investments in children (Kalemli-Ozcan 2003). Some of the improvement in child survival is itself a response to parental decisions to invest more in the health and welfare of a smaller number of children (Nerlove 1974). In addition, an increasing marketization of societies and the expansion of government services may imply that governments and/or market services replace many of the important economic functions of the traditional family and household, like risk sharing, insurance and the provision of retirement income, further weakening the value of children (Becker 1991). The extent to which family planning programs and contraceptive technologies affect fertility is hotly debated, and we return to this question in Section 3.4 below.

Many of the above relationships between the fertility and its individuals and societal determinants have been extensively studied. For example, one of the strong empirical

relationships in developing countries that has received considerable attention from this perspective of how opportunity costs shape fertility outcomes, is a negative association between mother's education and children ever born (Caldwell 1980; Kravdal 2002; Schultz 1997). Using aggregate data in developing countries, for example, Schultz (1997) finds—consistent with the implications of the new home economics—that male education and income from non-human-capital sources are associated with higher fertility. Kravdal (2002) also suggests that education effects on fertility exist not only at the individual-level, but also at the community level net of urbanization and her own education. Rosenzweig (1990) and Rosenzweig and Wolpin (1980) provide evidence for the quality-quantity trade-off in developing countries by utilizing exogenous variations in the wage of children to infer child-costs and the incentives for child-quality versus quantity, or using twin births as a natural experiment. Evidence for this trade-off is also found using scholastic performance as an indicator for child-quality Hanushek (1992), although some newer studies using gender composition for the first-born children as instruments for overall fertility, have found negligible quality-quantity trade-offs in some developed countries (Black et al. 2005). In addition, individual learning about fecundity has been shown as an important factor in the determination of fertility (Rosenzweig and Schultz 1985), and uncertainty about socioeconomic conditions during early adulthood has been shown to be an important motivation to delay childbearing (Bernardi et al. 2008; Johnson-Hanks 2006). Using overlapping generations models, for example, Galor and Weil (1996) suggests that technological progress leads to reduced fertility because it increases the ratio of women's to men's wages, thereby increasing the opportunity costs of children and increasing the motivations to invest in child quality. Manuelli and Seshadri (2009) argue in a recent study based on an overlapping generations model that cross-country differences in productivity and taxes go a long way toward explaining the observed differences in fertility across contemporary developed countries, and Greenwood et al. (2005) point to the importance of the relentless rise in real wages during the last 200 years in contributing to increased the opportunity cost of having children, while at the same time, arguing that the baby boom during the 1950–60s is explained by an atypical burst of technological progress in the household sector that occurred in the middle of the last century that lowered the cost of having children. Substantial fertility decline have occurred in societies across a broad range of development stages and across the religious spectrum (Rosling 2012), with Muslim countries exhibiting somewhat fertility in a recent study of 30 contemporary developing countries (Heaton 2011). This relationship, however, is subject to considerable variability, and interestingly, the Muslim/Christian difference grows wider at higher levels of development and at higher levels of educational achievement. In addition, long-standing differences in norms and beliefs about the appropriate role of women in society, and specifically with respect to the division of labor in the household and female labor force participation, that are not necessarily tied to religion may have important influences on fertility. For example, in a recent set of papers Alesina et al. (2011a,b) also show that the form of agriculture traditionally practiced—intensive plough agriculture versus shifting hoe agriculture—affected historic gender norms and perceptions of gender equality, and that these norms and perceptions not only affected historical fertility levels but resulted in long-lasting fertility differences that continue to persist in contemporary contexts around the world today (for related analyses of post-WWII fertility trends, see Fernández et al. 2004).

Recent economic theories have also developed more explicitly the decision processes within households about fertility and related behaviors. For example, the above models concentrate on a single decision-maker and disregard the fact that household decisions usually involve more than one person who may not agree about the respective factor allo-

cations. Various assumptions, such as Becker's (1974) "*Rotten Kid Theorem*", establish circumstances under which households act as if they were governed by a single, utility maximizing decision-maker. Empirical evidence, however, tends to contradict this assumption (Haddad and Hoddinott 1994; Schultz 1990), and bargaining theories (Bergstrom 1997; Lundberg and Pollak 1996) provide a sophisticated framework for analyzing this process for fertility and other household decisions. Bargaining between partners (or spouses) can have complex implications for fertility decisions because, among other factors, the ability to dissolve unions, the well-being outside marriage, or the withhold care or services within a relationship are important determinants of bargaining power in these models. For example, England and Folbre (2002) argue that primary care givers (usually mothers) usually have less bargaining power than parents whose contributions simply take the form of financial support, and that this weakness in the bargaining process may not be fully compensated by the less tangible, non-pecuniary resources that result from greater physical proximity and stronger emotional connection to the child. Within this view, less gender specialization in the form of parental involvement could lead to improved outcomes for children not only by improving mothers' economic position but also by strengthening emotional connections between fathers and children. Using similar views about gender asymmetries in decision-making processes within and outside the family/household, McDonald (2000) argues that an increase in gender equity—and thus more gender-equal bargaining power within families—is a precondition of a rise in fertility from very low levels in developed countries, while at the same time, increased female bargaining power is a necessary condition for achieving lower fertility.

It is well-known that the individual decision-making processes that are emphasized in the economic frameworks of fertility do not necessarily result in an optimal fertility level that maximizes some specific indicator of societal well-being like income per capita or subjective well-being; or, for that matter, neither do individual decision-making processes necessarily result replacement level fertility (for related discussions, see Lee and Mason 2012; Samuelson 1975; Strießnig and Lutz 2012). For example, it is an old observation that individuals' fertility decisions may deviate from the socially perceived optimum level of procreation. Polybius (1927, 36.17.5–7) in the second century BC, for instance, lamented about a decreasing population and a decline of cities because "*men had fallen into such a state of pretentiousness, avarice, and indolence that they did not wish to marry, or if they married to rear children born to them, or at most as a rule one or two of them, so as to leave these in affluence*". Instead of this concern for underpopulation, recent writers about the divergence between individually and socially desired population growth were primarily concerned with overpopulation. The reasons for this divergence are twofold: the first is that the relative prices of goods and services that households face may simply be "*wrong*" due to market or policy failures. The second is provided by the ubiquitous phenomenon of externalities. The externalities underlying this divergence of private and social incentives for low fertility are mainly found in three areas. In Malthus' model that emphasizes diminishing returns and the finiteness of space as limits to population increase, the externality is pecuniary and relates to the negative effect of an additional worker on the wage level. Alternative externalities can arise due to public goods or natural resources. An early modern formulation of the "*tragedy of the common*" is provided by Hardin (1968). Motivated by this existence of common resources, Demeny (1986) described the population problem as a prisoner's dilemma, in which each couple, acting in their self-interest, induces suboptimal collective outcomes. The existence of a prisoner's dilemma has been used to advocate population policy and public intervention in individuals' fertility decisions. Yet even if one accepts the relevance of negative externalities, little is known about their magnitude. A study by Lee

and Miller (1991) is one of the few attempts to estimate them in the context of developing countries. Contrary to the expectation, “[f]or some countries widely viewed as having serious population problems, the net total of these quantifiable externalities was close to zero” (p. 295). In developed countries where concerns about low fertility are prominent, however, the externalities to childbearing are substantial. Instead of the negative spillovers that dominate the concerns of excessive population growth, these arguments focus primarily on the positive externalities to childbearing resulting from the existence of public transfer and related systems that—in their net effects—transfer resources from the younger to older generations. In addition, as argued by Simon (1981) and Boserup (1981), a larger population could imply a greater probability of increases to knowledge that is a public good (although this positive effect is reduced if knowledge and information are shared relatively easily globally). In this contexts, children tend to be associated with positive externalities, resulting in lower than socially optimal fertility levels, because the discounted contributions of children to these systems exceed the discounted benefits they receive.

In addition to the above focus on economic externalities, fertility models that include social interaction and social learning have emphasized possibly positive externalities—or spillovers—that arise because the adoption of reduced fertility by some parents contributes to the erosion of traditional norms or pressures to conform (e.g., Kohler 2001). Other forms of social interactions are possible, including also the returns to education or feedbacks affecting the marriage market. For example, these externalities occur because the diffusion of information is a path-dependent process and the choices of early adopters influence the availability of information for later decision-makers (Kohler 1997).⁸ Externalities exist in health behavior due to threshold phenomena in the spread of contagious diseases. Alternatively, they emerge in economic development because the return to human capital depends on the average level of education in a community. Or, as Goldin and Katz (2002) argue, during the introduction of the pill that altered women’s career decisions in through two pathways: a direct pathway that through better fertility control facilitated women to invest in expensive long-duration training without the price of abstinence or a high risk of unwanted fertility, and an indirect pathway in which the resulting delay of marriage increased the size of the marriage pool at older ages, thereby reducing the costs of delaying marriage in terms of the probability of finding an appropriate mate. Alternatively, positive externalities may occur due to increasing informational returns in social learning about contraception and family planning. In particular, because information is to some extent a public good, private providers are not likely to supply it in adequate amounts. This is particularly the case when information (for example, about the possibility of controlling fertility) cannot be easily tied to a specific marketable product. Thus, information about rhythm and withdrawal has no private market, nor does information about the pill in rural areas where there is no real market for private medical services. Yet the welfare gains to individuals from accurate information of this kind may exceed the costs of providing that information (e.g., Behrman and Knowles 1998).

The information problem may be particularly severe in the context of family planning where the product is a complex set of ideas and procedures whose benefits are not immediately apparent, but whose perceived risks may be high. In addition, much information—

⁸In the context of family planning programs, discussed in more detail in Section 3.4 below, evidence for relevant social interaction effects on fertility is also provided by Freedman and Takeshita (1969), who report on a controlled experiment in which blocks of neighborhoods in Taichung (Taiwan) were exposed to different information about available family planning services, ranging from no explicit information to mailings and home-visits of field representatives. About half of all women who accepted family planning after the initial information campaign, heard about the program from friends, neighbors and relatives instead of the home-visits which provided the second most important source of information.

for example, regarding appropriate method and medical contra-indications—is client-specific and may be too sensitive and complex for the mass media to convey. Interactions between family planning and other maternal and/or child health programs/policies are also complex, with the benefits of the latter affecting the individual and societal costs and benefits of family planning. The failure of a market for contraceptive information in these contexts is frequently used to motivate family planning programs (see also Section 3.4 below). These programs use visits by field workers as an adjunct to mass media advertising. Alternatively, they may provide incentives for women to visit a health clinic and acquire information about birth control. This policy intervention is different from many other incentive programs that try to reduce the number of children per couple. Information provision does not affect the desired fertility directly, but rather helps couples to achieve their desired fertility level. Humanitarian or other objections, frequently raised in the context of other population policies, are less severe with respect to pure provision of contraceptive information. Information provided by family planning programs, however, is not the only possibility for women to learn about the availability or the properties of contraceptive methods. The possibility of missing markets and policy failures emphasizes that diffusion of information in social networks may be an important factor in contraceptive choice, and market and/or policy failures provide an economic rationale for the high prevalence of social learning in fertility decisions. A formal model of this diffusion is given in Kohler (1997), and the combination of social learning with family planning efforts in empirical studies may shed light on the different performance of these programs (Kohler et al. 2000). Moreover, social learning implies positive externalities that affect fertility dynamics during the demographic transition. These positive externalities, denoted informational increasing returns, are associated with the adoption of modern contraception because a new user can provide essential information to other women who are uncertain about the costs and benefits of modern family planning and low fertility (Kohler 2001).

3.3. Population Growth, Demographic Dividends and Economic Development

Economic development is often seen as a sufficient condition for the decline of fertility as virtually all developed countries have—at least in global comparison—low fertility rates and low intrinsic growth rates (Figure 2) (Kohler 2010), even if among the most advanced societies, fertility may slightly increase with development (Myrskylä et al. 2009). The more interesting—and much more debated—question is if reduced population growth, and the changes in the population age structure that result occur throughout the demographic transition, can possibly facilitate economic growth and development. This debate about the interactions between population growth and economic development has a long history, with influences of these debates on population policy ranging from the pessimistic approaches following Coale and Hoover (1958), to the *revisionist views* expressed by the National Research Council (1986). The former was decidedly neo-Malthusian and argued that rapid population growth impaired economic development through its negative effects on saving and capital dilution. The latter emphasized the ability of markets and institutions to adjust, and argued that rapid population growth can slow economic development, but only under specific circumstances and generally with limited or weak effects (Kelley 1988).⁹ This

⁹For example, the conclusions in National Research Council (1986) state: “On balance, we reach the qualitative conclusion that slower population growth would be beneficial to economic development for most developing countries. A rigorous quantitative assessment of these benefits is difficult and context dependent. Since we have stressed the role of slower population growth in raising per capita human and physical capital, it is instructive to use as a benchmark the effects of changes in the ratio of physical capital per person. A simple model suggests that the effect is comparatively modest. Using a typical labor coefficient of 0.5 in estimated production functions, a 1 percent reduction in the rate of labor force growth would boost the growth of per capita income by 0.5 percent per year. Thus, after 30 years, a 1 percent reduction in the annual rate of population growth (produced, say, by a decline in the crude birth rate from 37 to 27 per 1,000) will have raised production

report therefore ushered in period of uncertainty about the priorities that should be given to population policies (Sinding 2009), as well as what the content of these policies should be—a perspective that arguable fit well with the predispositions of the Regan Administration in the USA, that announced at the 1984 International Conference on Population in Mexico that “*population growth is in and of itself neither good or bad; is a neutral phenomenon. [...] The relationship between population growth and economic development is not necessarily a negative one.*” In a continuation of this revisionist theme that downplayed concerns about population growth, G. W. Bush declared during the 1991 World Population Week that “*every human being represents hands to work, and not just another mouth to feed*” (cited in Cohen 1995a), and in the perhaps most optimistic perspective, Simon (1981) wrote in his book on *The Ultimate Resource*, with the ultimate resource in the title referring to human ingenuity, that “*every trend in material welfare has been improving—and promises to do so indefinitely*”.¹⁰

More recently, informed by new theoretical and empirical research in the last two decades, the pendulum in the population and economic development debated has shifted again. A *revisionism revised* perspective emerged (Birdsall et al. 2001; Sinding 2009) that again reemphasizes important population–development interactions, including but not only as a result of potential “*demographic dividends*” (Bloom et al. 2002) that can arise during the demographic transition as a result of changes in the age structure after fertility starts to decline in the demographic transition (for related reviews, including some specific to the SSA context, see Birdsall et al. 2001; Canning 2011; Dyson 2010; Eastwood and Lipton 2011; Kelley 1988; Sippel et al. 2011; Teller and Hailemariam 2011). In addition, on a theoretical level, the *unified growth theory* (Galor 2005, 2011) has stipulated a new interest in theoretical models integrating demographic change and economic development. After a period where the revisionist perspectives have dominated the perceived wisdom on the interaction between population and economic development, the interaction between demographic change and economic development—including the role of family planning programs and reduced fertility for economic growth—has received considerable new attention on both the macro and micro level and utilizing both empirical and theoretical approaches.

The Malthusian mechanism by which a high level of population reduces income per capita may still relevant in poor developing countries that have large rural populations dependent on agriculture, as well as in countries that are heavily reliant on mineral or energy exports (Weil and Wilde 2009). For example, in a provocative simulation study calibrated to SSA contexts, Ashraf et al. (2008) study quantitatively the effect of exogenous health improvements—for instance as a result of policy interventions that target infectious diseases, such as malaria and tuberculosis, or result in improvements of life expectancy through better general health—on output per capita, accounting for the effects that these health improvements have towards increasing population growth through the resulting reduction in mortality (a related study with similar findings is Acemoglu and Johnson 2007). The striking finding of Ashraf et al. (2008) is that, due to increased rates of population growth that follow from these policies or interventions as a result of reduced mortality, the effects of the resulting health improvements on income per capita are found to be substantially lower than those that are often quoted by policy-makers, and may not emerge at all for three decades or more after the initial improvement in health. This emphasis on the Malthusian effects resulting from the more rapid population growth induced by health interventions that reduce mortality is controversial (Arndt et al. 2009; Bleakley 2008, 2010),

and income per capita to a level 16 percent above what it would otherwise have been. This would be a substantial gain, but by no means enough to vault a typical developing country into the ranks of the developed.”

¹⁰Quoted in Lam (2011).

and depends critically on the assumptions how fertility and human capital investments respond to health and other societal/technological changes that reduce the relevance of the Malthusian mechanism (see Lam 2011 and our earlier discussion in Section 2); but, nevertheless, the findings highlight how higher population growth resulting from interventions can potentially reduce the welfare and income gains resulting from improved health, and as a result, the general equilibrium effect of these policies are less than the partial equilibrium effects suggested by most micro-studies.

On the other hand of the spectrum of population–development debate, the optimists about the effects of population growth on economic development tend to emphasize the positive contributions of population to innovation, efficiency in use of productive factors, scale economies in transportation and communication, or institutional change. In the view of Boserup (1965, 1981), increases in population density induce shifts to more labor-intensive farming, and the induced development of new tools and techniques (for example, the plow) permits large increases in productivity. Urbanization has been seen as critical to this process in both historical and contemporary contexts (Glaeser 2011; Jacobs 1969). In one example documenting these interactions, Kremer (1993) constructs and empirically tests a model of long-run world population growth combining the Malthusian idea, that technology limits population, with endogenous technological progress. The model predicts that over most of history the population growth rate and the rate of technological progress are proportional to the population size. Empirical tests support this prediction and show that historically, among societies with no possibility for technological contact, those with larger initial populations have had faster technological change and population growth. The implication of the above models that high population density eventually leads to modernization is qualified by Lee (1986, 1988). The question of institutional adjustment, which weakens the effect of population growth on economic development, is crucially related to the question whether institutional adaptation is a necessary consequence of population pressure. Models with multiple equilibria and possible development traps raise some doubts with respect to this deterministic institutional adjustment (Becker et al. 1990; Dasgupta 1993; Galor and Tsiddon 1991). Instead of deterministic long-term modernization, for example, Lee's (1986; 1988) model also exhibits a 'Malthusian trap'. Depending on the initial combination of technology level and population size, and on the interaction between wages and fertility, the population may either modernize and reach an equilibrium with relatively high income and technology levels, or it may converge to a Malthusian situation where low levels of technology and low wages eventually restrict fertility. This feature of multiple equilibria questions the view of the 'pure' optimists that economic modernization is a deterministic consequence of population growth. Arthur and McNicoll (1978), for instance, describe a situation in Bangladesh that seems to fit the description of this trap. They report that peasants 'seem quick to sense opportunities for even marginal progress' (p. 57), but social and economic pressures on families combine to push fertility upward towards a high level, leading to declining wages and severe environmental problems. At the same time, these institutions, such as a lack of political and local organization and a low status of women, seem to be self-enforcing. Although the authors see potential for socioeconomic change and modernization, they also question the improvement through induced progress as outlined in the optimists' perspective. More recently, McNicoll (2011) have emphasized the divergent demographic and development paths of two relatively resource-rich countries: Indonesia and Nigeria. A half century ago, Indonesia and Nigeria appeared to be similarly placed in development level and both had high fertility and high mortality. In the interim period, however, these countries followed radically different trajectories: Indonesia moved toward an East Asian style of growth accompanied

by a progressive reduction of poverty, whereas in Nigeria growth stagnated, the economy became increasingly dominated by oil and natural gas revenues, and poverty remained undiminished. In addition, the demographic transition in these countries unfolded very differently: while Indonesia currently has a life expectancy close to 70 years and fertility averaging little over two births per woman, Nigeria's life expectancy is still below 50 and its fertility is above 5. McNicoll (2011) argues that this divergence in demographic and economic trajectories during the last fifty years between Indonesia and Nigeria is due to differences in governance and policy choice, in inherited resources and institutions, and in external conditions. Specifically, with respect to fertility, McNicoll argues that differences in institutional inheritance have been especially important, putting significant obstacles in the way of a Nigerian fertility decline that were not present or could be fairly readily overcome in Indonesia.

In a paper addressing the possibilities of a Malthusian trap that prevents long-term modernization, Becker et al. (1990) combine a theoretical growth model with endogenous fertility choice according to the new home economics. They argue that human capital investments are an important part of modernization, and that parental decisions about these questions are crucial for understanding fertility transitions. The analysis assumes that the rates of return on investments in human capital rise rather than decline as the stock of human capital increases, at least until the stock becomes large. The model exhibits two equilibria, corresponding respectively undeveloped and developed economies respectively. The latter is characterized by higher per-capita human capital and income, and lower fertility. As a result of these multiple equilibria that result from the interaction of individual-level returns to human capital and aggregate levels of human capital, and undeveloped economy can be "*stuck*" at the high fertility low-development equilibrium unless sufficiently favorable technology becomes available or external shocks disrupt the initial equilibrium. Becker et al. (1990) thus conclude that "*history and luck are critical determinants of a country's growth experience*" and that "[m]any attempts to explain why some countries and continents have had the best economic performance during the past several centuries give too little attention to accidents and good fortune."¹¹

The emphasis on initial conditions and exogenous shocks for the selection between equilibria in the above model leaves the reader somewhat uncomfortable because it leaves relatively little room for policy interventions or endogenous social processes that affect the pace of fertility decline and development. Kohler (2000), for example, investigates this selection of equilibria in terms of a *coordination problem*. Expectations emerge in this context as a key determinant of the equilibrium selection. High fertility is rational as long as high fertility is a predominant behavior in the population, and low fertility emerges as a rational choice if a critical mass of other community members follows suit. The main difference is that contemporary or future individual behavior is a potential source of divergence in a society's evolution, and that there is the possibility of self-fulfilling prophecies. An economy may remain undeveloped with high fertility because everyone believes that it will. Institutional contexts, including also the existence of inclusive or extractive political institutions and elites emphasized in Acemoglu and Robinson (2012), are potentially important determinants of such shared expectations and perceptions. However, if changes in expectations occur, they can imply behavioral changes and may influence the long-term equilibrium selection. Such expectation-driven equilibrium selection is particularly relevant in fertility decisions. Specifically, expectations about future development trajectories and social/economic conditions are important because many externalities associated with

¹¹For a critical discussion of Becker et al.'s (1990) model and its ability to describe basic empirical patterns of the onset of the demographic transition, see Galor (2005, 2011).

fertility decision are local (Akerlof 1997; Dasgupta 1993, 1995). These local externalities pertain either to the return on human capital investments as argued by the literature cited above, or they pertain to the social acceptability of contraception, the prevalence of pronatalist traditional customs, or social norms that affect the status of women. All of these factors are endogenous to the aggregate prevalence of fertility control in the population. They imply that the incentives to reduce fertility depend, at least in part, on the behavior of other community members. A transition from the high fertility equilibrium towards a persistent fertility decline can be initiated if a coordinated critical mass of behavioral change occurs. This observation provides a theoretical motivation for the 'tipping' or 'threshold' models suggested by Schelling (1978) or Granovetter (1978).

Recently, the unified growth theory (Galor 2005, 2011) has elaborated on the above mechanisms and has started to provide an integrated perspective on both demographic change and economic development that is consistent with the demographic and economic trends and patterns during the demographic transition. The motivation behind this framework is the claim that the understanding of the contemporary growth process would be limited and distorted unless growth theory would be based on micro-foundations that would reflect the qualitative aspects of the growth process in its entirety. And while there remain some controversies about whether the specific mechanisms postulated in these models are consistent with the empirical evidence (Guinnane 2011), the dynamics of demographic change and economic development—along with the dynamics of changes in technology, human capital levels, fertility and mortality—is broadly consistent with the observed patterns during the demographic transition. Most importantly for the present discussion, the unified growth theory suggests that the transition from stagnation to growth is an inevitable outcome of the process of development. In the pre-transition Malthusian period, the interaction between the level of technology and the size and the composition of the population accelerated the pace of technological progress, and ultimately raised the importance of human capital in the production process. Technological progress hence becomes sustained and cumulative, and agricultural techniques and the mechanization of agriculture make the fixed factor, land, less important and less of a constraint for population growth and improvements in living standards. Technological progress also leads to new methods of production, and new research methods for producing new technologies, which increase the returns to education. This leads to a quality-quantity trade-off: families choose to have fewer children in order to allow investments in education that will make these children better off. As a result, the rise in the demand for human capital in the second phase of industrialization, and its impact on the formation of human capital as well as on the onset of the demographic transition, brought about significant technological advancements along with a reduction in fertility rates and population growth, enabling economies to convert a larger share of the fruits of factor accumulation and technological progress into growth of income per capita, and paving the way for the emergence of sustained economic growth.

Two aspects of the unified growth theory are important for the present discussion about the determinants of the onset and pace of the fertility transition during the demographic transition. First, the fertility transition within the framework of the unified growth theory is triggered by the gradual rise in the demand for human capital that cause parents to shift from child quality to child quantity (Galor 2011, 2012). Second, the theory argues that international trade was an important reason for the differential timing of the demographic transition, including those occurring in the 2nd half of the 20th century in less developed countries. In particular, contrary to the process occurring in developed countries, international trade in non-industrial economies generated incentives to specialize in

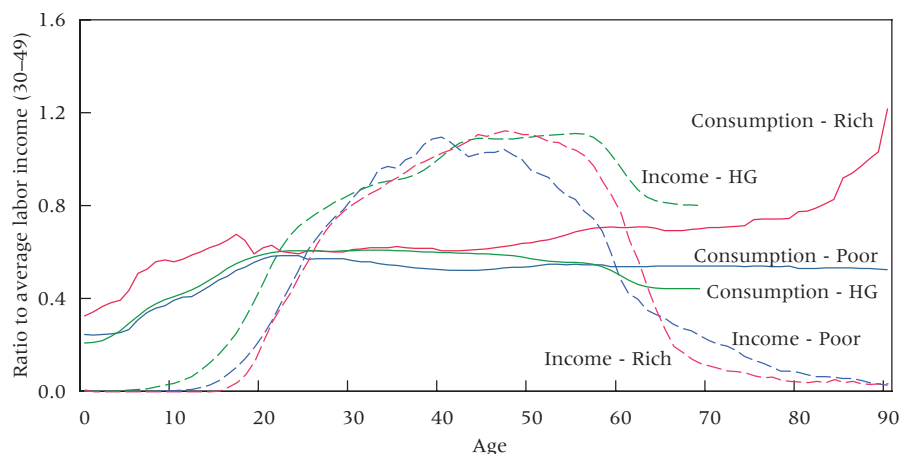


Figure 10: The economic life cycle of hunter-gatherers (HG), poor agricultural populations, and rich industrial populations: Consumption and labor income (ratio to average labor income, ages 30–49)

Source: Lee and Mason (2011)

the production of unskilled intensive, non-industrial, goods. Hence, the absence of significant demand for human capital reduced the incentives to invest in the human capital and child quality, and the gains from trade were utilized primarily for a further increase in the size of the population, rather than in the income of the existing population. As a result, the demographic transition in these non-industrial economies has been significantly delayed, increasing further their relative abundance of unskilled labor, enhancing their comparative disadvantage in the production of skilled intensive goods, and delaying their process of development. International trade therefore reinforced the “*great divergence*” in income per capita across countries during the 19th and 20th century, and affected persistently the distribution of population, skills, and technologies in the world economy. And yet, the prediction of the theory is that the demographic transition, and the transition from stagnation to growth have been merely delayed, and that ultimately the mechanisms and processes emphasized above would result in both demographic and economic change.

A further important contribution that caused the pendulum in the debate about the role of population change and economic development to reverse has been made by scholars who shifted away from focusing on the size of the population, and explicitly recognized different stages of the life course and the different economic contributions (positive and negative) to economic growth at different stages of their life-course. Recent years have brought about a hugely improved understanding of the economic life-cycle across over time and across different stage of economic development (Lee et al. 2006; Lee and Mason 2011) (Figure 10). These distinct phases of the life cycle with different patterns of savings, intergenerational transfers, labor force participation and human capital have received considerable attention as potentially important factors that determine the interactions between population growth and development. In particular, as the population age structure changes during the demographic transition—as is for instance illustrated based on recent and projected age structure changes for South Africa and all of SSA combined in Figure 11—the proportion of the population that are children (young dependents), working-age adults (and thus net producers), and elderly individuals (who are net consumers in developed, but not necessarily among the less and least developed countries) shifts. Specifically, during the next decades, the proportion of the population that is in working ages will in-

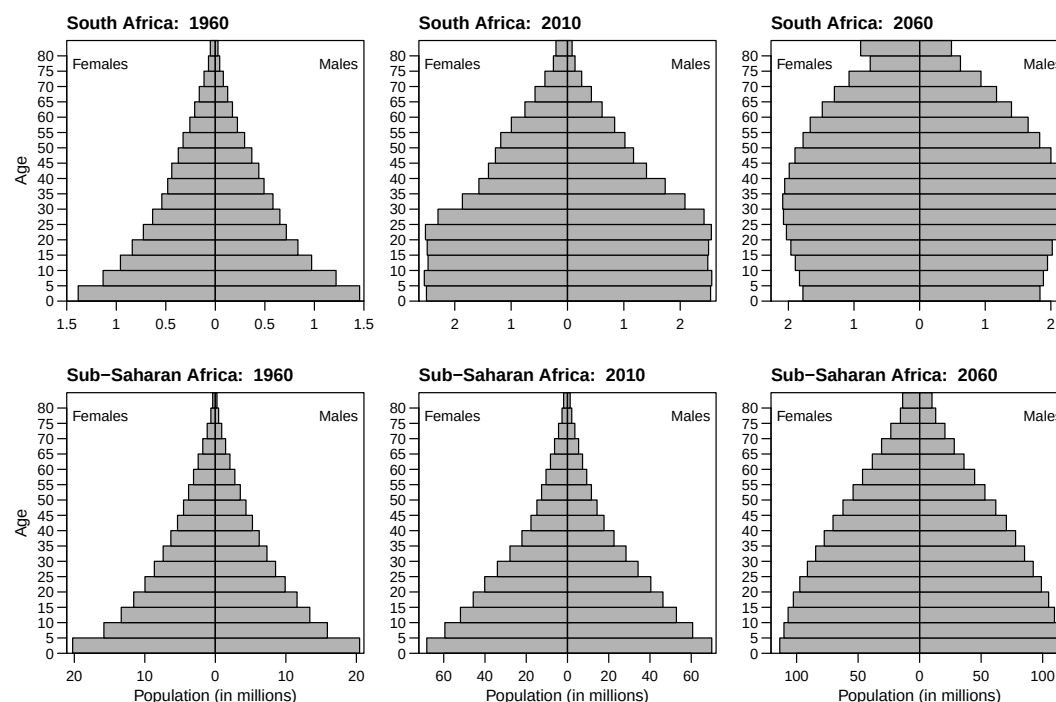


Figure 11: Population age structure in South Africa and sub-Saharan Africa, 1960, 2010, and 2060

Source: Based on UN median projections (UN Population Division 2010c)

crease markedly in countries like South Africa, which has experienced a substantial decline in fertility in recent decades (Table 1), as well as to a more modest extent in sub-Saharan countries overall where the average pace of fertility decline has been slower (Figure 11). This increase in the proportion of the population that is in working ages will be least pronounced in the countries that continue to grow rapidly during the next decades, such as the countries included in Table 2. Recognizing these shifts in the population age structure during the demographic transition, several studies have started to investigate at the impact on economic growth not only of population growth rates, but also of changing age structures changes (Bloom and Canning 2004, 2008; Bloom et al. 2002). Specifically, this literature hypothesized that economic growth might benefit from a one-time “*demographic dividend*” caused by the fact that, as fertility falls, the fraction of the population in working ages increases.

Part of this effect of age structure on per capita growth is *arithmetic* and follows from the composition $g(Y/N) = g(Y/L) + g(L/WA) + g(WA/N)$, where $g(\cdot)$ denotes the growth rate, Y is output, and N , L and WA are respectively the size of the population, labor force and working age population (for simplicity, we assume here no unemployment). If productivity per worker (Y/L) and the proportion of the working age population that is in the labor force (L/WA) are constant, an increasing share of the population that is at working ages (i.e., $g(WA/N) = -g(1 + \text{dependency ratio}) > 0$) will necessarily increase the rate of growth of per capita income. But the literature on the demographic dividend points out that the effect of changing population age structure may be much stronger than this merely arithmetic effect. For example, a fall in the dependency ratio—especially the fall in the young dependency ratio that a fall in fertility following a decline in mortality will bring about—may well induce more participation of females in the labor force and raise savings.

There may also be more investment in child quality as fertility declines, and human capital is likely to increase (most pronounced for women and children). As regards savings, if the population is considered as consisting of dissaving dependents at both ends of the age spectrum plus saving workers in the middle (Figure 10), then the early consequences of a fall in fertility will be to raise savings ratios, by reducing the weight of young dissavers in the population. It is also possible that falls in fertility simultaneously raise females' participation and savings, in which case both financial and labor-market conditions will favor the investment that will facilitate gainful employment of the extra labor.

Proponents of the demographic dividend theory argue that these aspects are of considerable importance for understanding the economic development in the context of the demographic transition, and that the age-structure changes during the early stages of the demographic transition, along with behavioral changes that cause it and result from it, have been an important factor in the rapid growth that have been described as the East Asia's "*economic miracle*" and Ireland's emergence as a "*Celtic Tiger*". To test this hypothesis about the impact of age structure changes on economic growth, the recent literature on the demographic dividend has estimated versions of models of the form $g(Y/N) = \phi + X\beta + \delta(Y/L) + \gamma g(WA/N)$, where γ indicates the effect of changes in age in the proportion of the population in working ages—which tends to increase as fertility declines—on per capita income. The arithmetic dividend that follows from only the increase in the proportion of the population that is at working ages would imply that $\gamma = 1$. Empirical estimates for γ , however, range from 1.5 to 3.5—with the higher of these figures obtained for African countries (e.g., Bloom et al. 1998, Table 6). These effects therefore suggest that the "*demographic dividend*" resulting from age structure changes substantially exceeds the arithmetic effect that follows from the compositional change by 50–200%, and this additional effect of increases in the fraction of the population in working ages results from changes in fertility, savings, human capital and female labor force participation that occur as part of the demographic transition. Using related analyses that document that higher dependency ratios (including both youth and old-age dependency ratios) have a significant impact on growth, Kelley and Schmidt (2005) conclude that, worldwide, the combined impacts of demographic change have accounted for approximately 20% of per capita output growth impacts, with larger shares in Asia and Europe.

However, the literature on the demographic dividend also emphasizes that, both theoretically and empirically, the link from demographic change to economic growth is not automatic (Bloom et al. 2002). There is an important role of initial conditions and path dependence (see above). Age distribution changes merely create potential for economic growth. Whether or not this potential is captured depends on the policy environment, including for instance the quality of governmental institutions, labor legislation, macroeconomic openness management, seems to trade, and education policy. According to Bloom and Canning (2008), this is the realm where Latin America stumbled during 1965 to 1990, and economic performance lagged behind that of East and Southeast Asian countries despite similarly favorable demographic conditions. During East and Southeast Asia, but its economic performance well behind. And the policy and institutional environment is of course critical for evaluating the potential of a demographic dividend in sub-Saharan Africa (Eastwood and Lipton 2011; Sippel et al. 2011). While Bloom et al. (2007b) find that the relationship between demographic change and economic growth in Africa is much the same as in other regions, primarily those sub-Saharan African countries with good institutions and increasing shares of the population in working-ages are likely to be the ones that will reap a demographic dividend. However, from the perspective of analysts worried about future population growth, these likely beneficiaries from the demographic dividend

are the countries that have already made most progress in reducing fertility and maintaining economic growth. Hence, a more pessimistic assessment about the prospect of a demographic dividend in SSA high fertility countries is provided by Eastwood and Lipton (2011) who point out that, in comparison with the Asian experiences, many SSA countries have been characterized throughout the demographic transition by more rapid population growth rates and lower savings rates. In particular, while slower population growth will indeed raise sustainable consumption per head by reducing the savings that would be needed to sustain capital per person, this prospect pales into insignificance beside the likelihood that savings will fall far short of the level necessary for a sustained growth during the period when demographic conditions provide a context for a demographic dividend. In addition, Eastwood and Lipton (2011) question whether fertility declines—many of which have stalled and/or are progressing slowly (Bongaarts 2008; Ezech et al. 2009)—will be sufficiently fast to allow for the changes in dependency ratios that are currently suggested by UN median population projections.

In addition to cross-country and longitudinal country analyses, a related recent literature that exploits naturally occurring “*natural experiments*” (Rosenzweig and Wolpin 2000) has strengthened the case for important interactions between population change and economic and social development. Bleakley and Lange (2009), for example, investigate the eradication of hookworm disease from the American South (circa 1910), arguing that this eradication was principally a shock to the price of child quality because hookworm depresses the return to human capital investment, had a very low case-fatality rate, and had negligible prevalence among adults. Consistent with the quality-quantity trade-off model for fertility, Bleakley and Lange (2009) find that a decline in the hookworm-infection rate from 40% to 20% was associated with a decline in fertility that amounts to 40% of the entire fertility decline observed in the American South between 1910 and 1920; the eradication of hookworm was also associated with a significant increase in school attendance and literacy, and the combined effect of reduced fertility and increased child quality potentially importantly contributed to economic development. Focusing on variation in fertility more directly, Bloom et al. (2009a), for example, estimate the effect of fertility on female labor force participation in a panel of countries using abortion legislation as an instrument for fertility, documenting that removing legal restrictions on abortion significantly reduces fertility and increases female labor force participation since, on average, a birth reduces a woman’s labor supply by almost 2 years during her reproductive life. As a result, Bloom et al. (2009a) argue that that behavioral change, in the form of increased female labor supply, contributes significantly to economic growth during the demographic transition when fertility declines. Similarly using variation in access to abortion as a factor affecting fertility, Pop-Eleches (2006) examines educational and labor outcomes of children affected by a ban on abortions that was introduced in 1966 in Romania. Birth rates doubled in 1967 because formerly abortion had been the primary method of birth control. Controlling for socioeconomic differences in abortion use prior to 1966, the analyses find that children born after the ban on abortions had worse educational and labor market achievements as adults. There is also suggestive evidence that cohorts born after the introduction of the abortion ban had inferior infant outcomes and increased criminal behavior later in life. Acemoglu and Johnson (2007) exploit the large improvements in life expectancy driven by international health interventions, and find that GDP per capita and GDP per working age population show relative declines in countries experiencing large increases in life expectancy—an effect that is possibly due to the more rapid population growth induced by these life expectancy gains (for a critical perspectives on these findings, see Bloom et al. 2009b). Emphasizing these negative effects due to more rapid population growth in response to health interventions

in developing countries, Ashraf et al. (2008) evaluate changes in the prevalence of malaria and tuberculosis on health, productivity and population growth and conclude that the effects of health improvements on income per capita are substantially lower than those that are often quoted by policy-makers, and may not emerge at all for three decades or more after the initial improvement in health. Ashraf et al. (2008) thus argue that efforts to improve health in developing countries should rely more on humanitarian rather than economic arguments, since the economic growth consequences of such interventions may be small and occurring only after a significant delay.

3.4. The Role of Family Planning Programs and Related Policies

In the context of our previous discussions, an obvious question to ask, and yet a complicated question to answer, is whether family planning programs have made important *causal* contributions to declines in fertility, the attainment of other development goals (such as the Millennium Development Goals), and economic development. And if so, if these programs are suitable and cost-effective policy instruments to address the concerns about population growth and bring about progress in individual well-being.

In the 2nd half of the 20th century, family planning programs have been the primary approach in developing countries to address rapid population growth, high fertility and unintended childbearing, and poor reproductive health outcomes. These programs have tried to help individuals satisfy unmet need by increasing the supply of and access to contraception, as well as reduce other obstacles to contraceptive use such as fears about side effects, husband/familial disapproval, or lack of information/knowledge about contraception and/or the benefits of reduced fertility (see also Section 3.4). Usually less explicit because of the potential concerns about interfering with individual's/couple's reproductive decision-making, programs have also tried to affect the level of desired fertility—which the notion of unmet needs takes as a given—through reductions in the costs of fertility regulation, and reforms—such as restrictions on child labor or expansion of required schooling—that affect the costs and/or benefits of children (Schultz 2007). More recently, programs have also included a broader focus on reproductive and child health outcomes (Bongaarts and Sinding 2011a).

The first major family planning program was established in India in 1951, and by 1975 about 74 developing countries had established them (for reviews of family planning programs and their effectiveness, see Cleland et al. 2006; Joshi 2011; Population Council 2012; Robinson and Ross 2007; Seltzer 2002; Shiffman and Quissell 2012; for a recent broader discussion of population policies, see also Das Gupta et al. 2011; Demeny 2011; May 2012). During the 1980s, international interest in family planning program lost momentum, in part as a result of the “*revisionist thinking*” about population growth (Section 3.3) and in part in response to criticisms that these programs sometimes had problems in the implementation and were unpopular (Seltzer 2002). In addition, feminist critics argued that these programs were not integrated with a broader reproductive rights-based agenda, as a result of which women paid a high price for population policies since they were often viewed as passive “*targets*” who had to become “*acceptors*” of contraception (Dixon-Mueller 1993), and increasing opposition from religious groups (for a response to these criticisms of family planning programs, see Bongaarts and Sinding 2009). More recently, in light of the demographic trends highlighted in Section 2 and newer evidence about the effectiveness of family planning programs that is reviewed below, family planning programs—especially when they are broad-based, female-focused, voluntary and respectful of human rights—have regained some of their momentum and are receiving renewed attention (Bongaarts and Sinding 2011a,b; Cleland et al. 2006, 2012; Turner 2009). The rationale for these pro-

grams in recent discussions is therefore twofold (May 2012; Shiffman and Quissell 2012): first, the *reproductive health rights* argument that emphasizes the right of individual women (and couples) to control their reproduction, helping them to attain meaningful and healthy lives; and second, the *ecological argument* that rapid population growth and high fertility imply individual-level and societal-level negative consequences—such as slower economic development, environmental degradation, or poor health outcomes—which could be reduced through family planning programs that help reduce fertility and population growth.

In reviewing the evidence about family planning programs, which is often based on the experience in Asian and Latin America, and assessing the applicability of these findings to the current high fertility countries (Figure 4), specifically also those in SSA, it is useful to highlight some of the broad differences in family planning programs across these regions (Joshi 2011). On the one hand, in Asia (and mainly East and South Asia), most family planning programs aimed specifically at curtailing population growth through explicit policies such as the promotion of contraception and/or incentives for fewer children. On the other hand, in Latin America the programs were mostly promoted with the aim to achieve broader aims such as improving child and maternal health, rather than just reducing fertility. In contrast, African family planning programs were often implemented without explicit population policies, and they were often run by outside donors that were relatively small in scale (Joshi 2011). Kenya and Ghana, for example, established family planning programs in the late 1960s, and Tanzania did so in 1970. Senegal established an urban family planning program in 1976 and a rural program in 1979. Much of Francophone Africa, however, lagged behind this movement and remained largely untouched by the wave of interest in family planning programs throughout this period. Even where they were established, program in Africa often differed from their Asian counterparts. First, the focus was almost entirely on temporary methods, since permanent methods were regarded as culturally unacceptable (Caldwell and Caldwell 1987); however, establishing of a reliable supply chain and relatively easy access to family planning services proved to be challenging in an African context due to a relatively weak health system infrastructure (Caldwell et al. 1992). Second, African family planning programs were supported by a large number of international donors who rarely coordinated their actions with national governments or even among themselves, resulting in programs that were fragmented, relatively small scale and often subject to short-term budget cycles—all of which is in contrast to Asian and Latin American programs that were typically run by Ministries of Health and were backed by long-term budget commitments.

Despite these differences in implementation and design, family planning programs have in common that they emphasize relatively low levels of contraceptive use as a primary proximate determinate of high fertility. The reasons for not using contraception in high fertility contexts are often thought to include high levels of desired fertility, a lack of knowledge about the existence and availability of contraception, insufficient contraceptive supplies and services, the cost of contraception, an exaggerated fear of side effects, and opposition from spouses and other family member. Family-planning programs therefore often go beyond the narrow provision of physical access to contraceptive supplies and services, but also aim at reducing other obstacles of contraceptive use as well—including, for instance high levels of gender inequality, lack of female autonomy or knowledge about contraception, husband's opposition or social disapproval of family planning (Cleland et al. 2006). And if the arguments by Ashraf et al. (2008) and Acemoglu and Johnson (2007) have merit that the higher population growth resulting from mortality-reducing health interventions can potentially reduce the welfare and income gains that would otherwise result from improved health, family planning programs should potentially be integrated and jointly

implemented with other health interventions that aim at reducing infectious diseases or improving general health (for example, in the context of the Copenhagen Consensus 2012 project, Canning 2012 highlights this point in the discussion of infectious disease interventions).

Family planning programs can affect the costs of reducing fertility, both through subsidizing the cost of contraceptives and making them more readily available, thereby reducing the costs of obtaining/accessing contraceptives. Family planning programs can also increase the information about family planning methods and the potential benefits of reduced fertility, and they can potentially affect preferences for children either directly or through processes such as *social influence* or peer pressures (Section 3.2). Family planning programs can thus affect desired fertility, as well as help to reduce unwanted and mistimed birth—with the latter being representing a significant fraction of births in developing countries. For example, each year about 184 million pregnancies occur in the developing world, and 40% of these (74 million) are estimated to be unintended because they occur when women want to avoid or delay pregnancy (Singh et al. 2010). These unintended pregnancies end in abortions (48%), unintended births (40%), or miscarriages (12%) (Bongaarts and Sinding 2011a).

Proponents of family planning programs have long argued that these programs are effective and have made an important contribution to fertility declines during the 2nd half of the 20th century (Bongaarts et al. 1990; Bongaarts and Sinding 2011a; Cleland et al. 2006; Lapham and Mauldin 1985; Turner 2009). In a recent analysis, for example, Population Council (2012, Ch. 2) compares pairs of countries that are relatively similar in terms of social, economic, cultural and religious characteristics, but where one country implemented a large-scale family planning program and the other did not. Such country-pairs include (with the country with a family planning program in *italics*): *Bangladesh* and Pakistan, *Kenya and Uganda*, *Iran* and Jordan. In all of these pairs, the country with the family planning program (*Bangladesh*, *Kenya* and *Iran*) has experienced more rapid fertility decline after the implementation of the program than the matched comparison country. While the matching of comparison countries based on characteristics is an advantage of the analyses in Population Council (2012) as compared to earlier studies that related country and/or regional measures of family planning efforts to fertility declines, this line of research is often criticized because it is potentially subject to an endogeneity of family planning program measures that would tend result in an overestimation of the causal contribution of the program. It is also possible to find counter-examples; as (Lam 2012) points out, Colombia's fertility decline, which as associated with a very large family planning program, was about the same pace and magnitude as that of Brazil, which had virtually no organized family planning program (see also Potter et al. 2002). In several studies, therefore, after controlling for the possible endogeneity of the program effort, it has been frequently not possible to infer a significant (in a statistical sense) or relevant (in terms of relative magnitude) influence of family planning programs from aggregate country data (Schultz 1994). In a recent study in Indonesia, McKelvey et al. (2012) also question that the use of modern contraception is price-elastic, i.e., is responsive to one important dimension—the price of contraception—that is affected by family planning programs. In particular, McKelvey et al. (2012) exploit substantial variation in in prices and incomes that were induced by the economic crisis in the late 1990s and show that monetary costs of contraceptives and levels of family economic resources have a very small (and well-determined) impact on contraceptive use and choice of method—although it is not clear if this finding is specific to the particular Indonesian context.¹² The most prominent critique of family planning programs

¹²For an earlier study of family planning use during the Indonesian financial crisis, see Frankenberg et al.

has been provided by Pritchett (1994) who compared total fertility rates with various measures of wanted or desired fertility to argue that fertility variation between developing countries was mainly determined by desires for children, with 90% of fertility differences between countries being explained by differences in desired fertility, and that the claims that family planning affect fertility levels stems from inferring causation from association. More recent analyses that utilize the more extensive DHS data on wanted fertility (Lam 2011), which have become available since Pritchett's (1994) analyses, essentially continue to find the same results: an overwhelming fraction (83%) of the cross-country variation in TFR is explained by cross-country variation in wanted fertility. Hence, while unwanted fertility clearly exists in virtually all contexts, the evidence does not suggest that countries with higher levels of fertility have a larger gap between actual and wanted fertility. Based on his analyses (and consistent with the more recent analyses in Lam 2011), Pritchett (1994) thus concluded that the best way to reduce fertility is to change the economic and social conditions that make large families desirable, rather than investing in family planning programs¹³—a conclusion that caused considerable controversy at the time (Bongaarts 1994; Knowles et al. 1994). In light of these criticisms, Miller (2010) for instance summarizes the proponent's view on the effectiveness of family planning programs with *"believes about the importance of family planning programs are at times stronger than the evidence that supports them."*

While significant skepticism prevailed during the 1990s about the effectiveness of family planning programs, a recent literature has begun to shift the evidence about the role of family planning. For example, Gertler and Molyneaux (1994) analyzed the contributions of family planning programs, economic development, and women's status to Indonesian fertility decline from 1982 to 1987, and after controlling for the targeted (nonrandom) placement of family planning program inputs, concluded that 75% of the fertility decline resulted from increased contraceptive use, but was induced primarily through economic development and improved education and economic opportunities for females. And while the direct effect of family planning explained only about 4–8% of the decline in fertility, the dramatic impact of the changes in demand-side factors (education and economic development) on contraceptive use and fertility was possible only because, as a result of the established family planning programs in Indonesia, there already existed a highly responsive contraceptive supply delivery system. Montgomery and Casterline (1993) use regional time-series analysis to study the impact of Taiwan's family program. In addition to finding a direct effect of this program on fertility trends, they infer from the positive autoregressive behavior of fertility that there is clear evidence in support of within-township, but only weak evidence for across-township diffusion of fertility control that acts as a *social multiplier* of the direct program effects (see also Rosero-Bixby and Casterline 1994). Lam (2011) points out that the longitudinal analyses of *changes* in fertility yields a very different picture than the cross-sectional analyses of actual and wanted fertility in Pritchett (1994) (and updated in Lam 2011). In particular, declines in wanted fertility explain 53% of the mean decline in TFR, and the remaining 47% of the decline occurs without any change in wanted fertility—suggesting that women have improved their ability to achieve their fertility targets, possibly (in part) as a result of improved access to and/or knowledge about contraception. Miller (2010) studies the regional expansion of the family planning program in Colombia in the 1970s, the timing of which is thought to have been largely determined

(2003). I am grateful to Lam (2012) for pointing out these Indonesian studies.

¹³Pritchett (1994) points to the fact that family planning programs can improve the timing of first births, with have lifelong socioeconomic implications for mothers, and that these benefits can provide a better reason for justifying family planning programs rather the declines in fertility per se.

by exogenous factors. The study finds that exposure of a woman to family planning from age 15 to 44 during the 1970s is associated with a reduction in cumulative fertility in 1993 of 5% (about one-third of a child), explaining about 6–7% of the fertility decline in Colombia's major population centers during 1964–93 (and this contribution of family planning is similar to those identified by Gertler and Molyneaux 1994). Hence, other factors—such as socioeconomic changes occurring during the same period—were more important determinants of the reductions in life-time fertility. The effect of the family program increases to reductions in life-time fertility of 10–12% for women who started to use contraception as a result of the program in the late 1960s and 1970s. In addition to declines in fertility, exposure to the family planning program when women were teenagers resulted in improvements in her educational attainment of 0.05 years, and an increase by 7% in the probability of working in the formal sector, an inter-generational increase in her children's schooling, and a delay in a child's first birth—the latter potentially being most important for the socioeconomic gains resulting from the family planning program exposure while being a teenager. The study also finds evidence that mothers with longer community exposure to family planning programs are associated with children who are more likely to be attending school, have completed more years of education, are less likely to work in the formal sector, and are less likely to have already had a child of their own by the time of the 1993 census. Similar conclusions are obtained by Pörtner et al. (2011) who evaluate the effects of family planning in Ethiopia, using a novel set of instruments that are based on ordinal rankings of area characteristics, motivated by competition between areas for resources. Access to family planning is found to reduce completed fertility by more than one child among women without education, while no effect is found among women with some formal schooling. These findings therefore also suggest that family planning and formal education act as substitutes, at least in the low-income, low-growth setting of Ethiopia. Pörtner et al. (2011) conclude that these results support the notion that increasing access to family planning can provide an important, complementary entry point to kick-start the process of fertility reduction. Such effects of changes in access to family planning are not restricted to developing countries. Following up on Goldin and Katz's (2002) analyses on the "*power of the pill*" in the United States, for example, Bailey (2006) use plausibly exogenous variation in state consent laws to evaluate the causal impact of the pill on the timing of first births and extent and intensity of women's labor-force participation. The results suggest that legal access to the pill before age 21 significantly reduced the likelihood of a first birth before age 22, increased the number of women in the paid labor force, and raised the number of annual hours worked.

Several other studies also point to the broader impacts of family planning programs beyond their effect on fertility. Specifically, cross-sectional analyses suggested that birth to young mothers and births following short birth intervals were associated with elevated mortality risks, and that by reducing these risky births, family planning programs would contribute to declining infant mortality (Bongaarts 1987). For example, Rosenzweig and Schultz (1982) finds that in urban areas in Colombia the availability of medical services—including in particular also family planning activities—in addition to mother's education, are associated with child mortality and fertility within a birth cohort of mothers. The least educated mothers were the most strongly affected in terms of a reduced fertility and increased child survival by these local urban health programs (similar results are also found by Miller 2010); no effects of program interventions and medical facilities are found on rural populations, even though both child mortality and fertility are lower for more educated rural women. Rosenzweig and Wolpin (1982) additionally show that services such as governmental health, education and family planning programs are more effective in shift-

ing resources from increasing family size to augmenting human capital per person when they are provided jointly. In particular, the results show that reductions in the costs of medical services, contraceptives and schooling and the improvement of water sources are mutually reinforcing alternatives for implementing the joint policy goals of reduced population growth and increased human capital formation. Rosenzweig and Wolpin (1986) find that family planning programs have positive effect children's health (as measured by child height) in the Philippines, suggesting that family size and child health might be gross substitutes, which might explain why some areas had a family planning clinic but not a health clinic. Do and Phung (2010) also emphasize the potential positive consequences of children being "*wanted*", which is important as family planning programs are likely to reduce "*unwanted*" fertility and increase the fraction of children that are wanted by their parents. In particular Do and Phung (2010) exploit the fact that in Vietnam the year of birth is widely believed to determine success. As a result, cohorts born in auspicious years are 12 percent larger, and Do and Phung (2010) argue that this increase is primarily driven by wanted fertility. Comparing siblings with one another, those of auspicious cohorts are found to have two extra months of schooling (despite the larger cohort size in auspicious years), lending support to the conclusion that children benefit from being "*wanted*" in terms of schooling and possibly other child outcomes (for a related earlier study with similar findings, see David 2006; Dytrych et al. 1975). Instead of focusing on unwantedness, using twins data and estimates from China, (Rosenzweig and Zhang 2009) study the consequences of having an extra child as a result of a twins birth and find that an extra child at parity one or at parity two, net of one component of birth-endowment effects associated with birth weight, significantly decreases the schooling progress, the expected college enrollment, grades in school and the assessed health of all children in the family. Nevertheless, despite the evident significant trade-off between number of children and child quality in this Chinese context, Rosenzweig and Zhang (2009) conclude that the contribution of the one-child policy in China to the development of its human capital was modest, primarily because the effect of the one-child policy on fertility was assessed to have been relatively small.

All of the above studies are potentially affected by econometric problems that hamper studies relying on observational data and that try to identify causal program effects—if they make any attempt to do so at all—by relying on longitudinal observations that allow controls for fixed effects, and/or instruments that affect family planning programs, and outcomes such as fertility only through their effect of family planning (for a discussion, see Moffitt 2005, 2009). While not without their own set of limitations (Deaton 2010; Duflo et al. 2007; Moffitt 2005), the most convincing evidence about the effects of family planning program is often thought to be derived from controlled experimental designs that allocated family planning programs across regions or villages in a randomized fashion. Fairly early evidence from such randomized experiments exist that family planning programs affect contraceptive uptake, both through direct exposure to the program as well as through social networks. For example, Freedman and Takeshita (1969) report on a controlled experiment in which blocks of neighborhoods in Taichung (Taiwan) were exposed to different information about available family planning services, ranging from no explicit information to mailings and home-visits of field representatives. About half of all women who accepted family planning after the initial information campaign, heard about the program from friends, neighbors and relatives instead of the home-visits which provided the second most important source of information. Mailings had virtually no effect on increasing women's propensity to adopt family planning. There is also a substantial amount of evidence in the form of responses from women in (focus-group) interviews who state that friends and neighbors were either important sources of information about contraceptive

methods, or that the consent of friends was an important factor in their decision to use contraception—which may importantly contribute to the social multiplier effects that have been associated with family planning program efforts (Kohler 2001; Montgomery and Castlerline 1996). Six month after the program, TFR declined more rapidly in Taichung as compared to other cities—6.4 vs. 3.1%. Sunil et al. (1999) report on a *Ammanpettai Family Welfare Program* controlled experiment, which used an monetary incentive program, combined with a motivational program using trained contact persons who visited and followed up with eligible women in the program area, to encourage contraceptive use among rural Indian women. While Stevens and Stevens (1992) found that the a modest cash incentive for 3–5 months attracts very large numbers of women to a clinic where they learn about and are provided with the pill, condoms, or the IUD, Sunil et al. (1999) show that the motivational programs were more likely to improve long term use of temporary family planning methods than cash incentive programs, suggesting that peer-based family planning education and training in community work to contact persons who make door to door visits to promote family planning programs can be an important part of these programs.

While the above family planning experiments can be used to document the effect of the program on contraceptive uptake, it is not useful for answering the more important questions of whether this update of contraceptive use contributed to declines in fertility and/or if these declines in fertility translated into broader socioeconomic gains. Unfortunately, as Schultz (2007) observes, “*Half a century of experience with implementing family planning programs throughout the world has produced few experimental evaluation studies which document the long-term consequences of family planning programs on family welfare. Estimating even the effect of programs on completed fertility of cohorts are rare and instead comparisons of adoption rates of new contraceptive methods or short run period birth rates are reported, few of which are experimentally designed, or statistically matched using propensity score methods or other satisfactory evaluation methods.*” One important exception to this statement is the Matlab Family Planning Experiment that was designed as a social experiment in a remote rural area of Bangladesh, in the Matlab Thana, in Bangladesh.¹⁴ This family planning program was initiated in half of 141 villages for which there was already in place a reliable demographic surveillance system of the population, registering all births, deaths, marriages and population movements.¹⁵ The family planning program outreach effort was started in October 1977, which contacted in their homes all married women of childbearing age every 2 weeks, offering them various methods of birth control. The populations were periodically censused and then randomly sampled in a comprehensive socioeconomic survey in 1996. A census in 1974 confirmed that the program treatment and comparison villages did not differ significantly 3 years before the program started in terms of their surviving fertility, approximated by the village ratio of children age 0–4 to women age 15–49. A difference-in-difference change between the program and comparison villages pre-program and post-program indicates that by 1982 surviving fertility is 17% lower in the program areas, and remained 16% lower in the 1996 survey after the program was in operation for nearly two decades. Fertility is lower in the program areas only for women less than age 55, presumably because women over

¹⁴The discussion of the Matlab program and its evaluation here follows closely Schultz (2007) and Schultz (2010).

¹⁵Miller (2010) points to some the criticisms that are often raised in the context of the Matlab experiment: (i) there is suggestive evidence that true randomisation was not fully achieved (Joshi and Schultz 2007); (ii) the Matlab family planning treatment was often considered too expensive to be financially sustainable without considerable external support—program expenditures per fertile women and per averted birth were roughly 10% and 120% of per capita GDP, respectively (35 times more than mean family planning spending in other Asian countries at the time) (Pritchett 1994); and (iii) because health services were integrated into the family planning treatment four years after the experiment began, it difficult to isolate long-run consequences uniquely attributable to family planning alone (Phillips et al. 1984).

55 were over 37 in 1977 when the program started, and these older women had essentially completed their childbearing at that time and hence their fertility did not respond to the program treatment (Joshi and Schultz 2007). It is possible to show that, subsequent to the Matlab family planning program, women age 25–55 in 1996 had about one child less in the program villages compared with the comparison villages. These women in program villages were healthier measured by their BMI being 1.0–1.5 units higher than in the comparison villages, and their children experienced a death rate by their fifth birthday which was 25% lower in the program villages. Moreover, girls age 9–14 and 15–29 had obtained about one-third of a standard deviation more years of schooling for their age and sex in the program areas, whereas the boys had obtained about half a standard deviation more schooling. The estimated program effect on the boy's schooling was statistically significant at the 5% level, whereas this schooling effect was not significant for girls. On the other hand, girls age 1–14 were reported to have a significantly higher BMI in the program villages, normalized for age, whereas there was no significant difference in BMI for boys (Joshi and Schultz 2007). Through the gains in BMI for women, the family planning may also contribute to extended benefits in terms of lower mortality for a period of up to 20 years (Menken et al. 2003). Women age 25–54 in 1996 also report monthly earnings a third higher in the program villages compared to the other villages, and the households in which women reside have proportionately more financial, agricultural, non-agricultural, and housing assets, more consumer durables and jewelry and household tube wells in the program villages (Schultz 2009). The wages of young men and women, age 15–24, did not decline—as would be predicted by Malthusian diminishing returns—in the program villages despite the tendency for there to be fewer children in these villages and they were more likely to attend school. Moreover, the wage rates for adult males age 25–54 are no higher in program areas than in the higher fertility comparison villages—in contrast to the wages of adult women that were at least one-third higher. The program also seems to have improved cognitive function at ages 8–14 among children who were eligible for the Matlab child health interventions in early childhood (Barham 2012).

Schultz (2010) concludes that, based on the study of the long-run consequences of policy-induced voluntary reductions in fertility in the Matlab program, *“in this poor rural South Asian region, a concerted outreach program achieved a significant decline in fertility and sustained lower levels of fertility for two decades, during which fertility has declined substantially in both groups of villages. This policy-induced reduction in fertility is associated with women and children being in better health, sons receiving more schooling, and women earning proportionately more in the paid labor market, and living in households with proportionately greater assets.”* These consequences of the family planning program are important, among other reasons, because they have been achieved in a rather impoverished agrarian context with low female education and low female labor force participation. Of course, based on a single study, it is difficult to assess if similar outcomes would follow from family planning programs in other parts of the world.

The Navrongo project in Ghana provides some evidence that some of the basic conclusions of the analysis of the Matlab experience will also hold in an SSA context, although it is not yet possible to make inferences about equally long-term effects of the family planning and health programs as for the Matlab project. Like the Matlab Project, the Navrongo Community Health and Family Planning Project is a quasi-experimental study designed to test the hypothesis that introducing health and family planning services in a traditional African societal setting will introduce reproductive change. At the core of the project is a four-cell study design, where in three randomly assigned regions a new basic primary health-care and family planning program were instituted in addition to the standard clinic-based ser-

vices provided by the Ministry of Health. The fourth region maintained the standard services only and is used as the comparison area for the project. Debpuur et al. (2002) show that knowledge of methods and supply sources increased as a result of exposure to project activities and that deployment of nurses to communities was associated with the emergence of preferences to limit childbearing. Fertility impact is evident in all treatment cells, most prominently in areas where nurse-outreach activities are combined with strategies for involving traditional leaders and male volunteers in promoting the program. In this combined cell, the initial three years of project exposure reduced the total fertility rate by one birth, comprising a 15 percent fertility decline relative to fertility levels in comparison communities. In addition, Phillips et al. (2006) show that the arm of the experiment that focused exclusively on delivering health services to women and their children succeeded in reducing childhood mortality rates by half but had a negligible impact on fertility, while the arm that focused on community-mobilization strategies and volunteer outreach led to a 15% reduction in fertility. This lends support to the argument that increasing access to contraceptive supplies alone fails to address the social costs of fertility regulation; effective deployment of volunteers and community mobilization strategies offsets the social constraints on the adoption of contraception. In addition, the Navrongo program—and in particular the provision convenient and easily accessible nursing care—has also resulted in significant reduction in infant and child mortality (Pence et al. 2007). As a result, the study claims that affordable and sustainable means of combining nurse services with volunteer action can accelerate attainment of both the International Conference on Population and Development agenda and the MDGs.

In addition, Ashraf et al. (2010) emphasize that in a SSA context, intra-household dynamics in contraceptive adoption may be of particular importance in how family planning programs affect contraceptive uptake and fertility, which has important implications for the design of these programs.¹⁶ In particular, Ashraf et al. (2010) find that women in Zambia who were given access to birth control individually, rather than in the presence of their husbands, were 23% more likely to visit a family planning nurse and 28% more likely to receive a concealable form of birth control, leading to a 57% reduction in unwanted births. In addition, providing cheaper and more convenient forms of birth control through a voucher program led to a reduction in unwanted births only when women were also given full autonomy over accessing these new methods. Specifically, using comparisons that approximate the impact of lowering barriers to accessing modern contraceptives while maintaining family planning policies that limit women's autonomy over these methods, such as through de facto spousal consent requirements that are still in place in much of SSA, Ashraf et al. (2010) find higher contraceptive use, but not a decline in unwanted fertility, in response to the program. Hence, it seems that the intervention primarily changed contraceptive use among women who were already fairly successful in preventing unwanted fertility. The findings by Ashraf et al. (2010) hence suggest that excess fertility in settings such as Zambia is not necessarily driven by the high cost of birth control; instead, unwanted fertility might be reduced by technologies or policies that shift control of fertility control from men to women.

4. COPENHAGEN CONSENSUS 2012: POSSIBLE SOLUTIONS FOR REDUCING POPULATION GROWTH IN HIGH FERTILITY COUNTRIES

Given the current debate that focuses on the role of family planning programs in addressing concerns about rapid population growth in some of the world's least developed coun-

¹⁶I am grateful to Lam (2012) for pointing out this study.

tries, we focus our benefit-cost calculations on family planning programs. In evaluating the benefits of these programs, the discussion in this 2012 Copenhagen Consensus Perspective Paper focuses on the implications of population growth on economic development, the potential effects of family planning programs on development as well as various measures of individual well-being. It is important to point out that there are several other implications of population growth that are not considered here, including the role of population growth on climate change, political instability and conflict. While these aspects are potentially importantly related to population change, their evaluation is beyond the scope of this paper (for a discussion of these issues, suggesting possibly large benefits in terms of environmental sustainability and reduced climate change from slower population growth, see for instance the recent Royal Society of Science report on *"People and the planet"* by Sulston et al. 2012, or the analyses of carbon emissions and population growth in O'Neill et al. 2010). The benefit-cost ratios presented below therefore are likely to be lower bounds to the extent that reduced population growth would result in additional benefits in domains such as climate change, political instability and conflict.

5. CHALLENGES OF BENEFIT-COST ANALYSES OF POLICIES TARGETED AT REDUCING POPULATION GROWTH

Conceptually, benefit-cost analysis is straightforward. Simply compare the benefits with the costs—if the benefits exceed the costs, or equivalently the benefit-cost ratio exceeds one, then an intervention is warranted (e.g., Belfield and Levin 2010). The benefits are simply the sum of the present discounted values of the weighted impacts of the interventions. Likewise the costs are simply the sum of the present discounted values of the real resource costs of the intervention. The devil—and the challenges—however, as usual are in the details. Before embarking on the benefit-cost considerations for family planning programs, therefore, it is important to highlight the challenges in doing so. Our review of the literature highlights the many uncertainties in assessing the determinants of fertility decline across a range of very different social and institutional contexts, and in assessing the role of family planning programs in facilitating declines in fertility and the attainment of other development goals. Moreover, the most robust empirical evidence is based on the Asian experience during the 2nd half of the 20th century, and with respect to family planning programs, the Matlab experiments in particular. The extent to which these findings are applicable to a contemporary SSA context, i.e., the world region with the highest concentration of high fertility countries (Figure 4), is at least somewhat uncertain. But even after acknowledging the limitations of the empirical evidence for conducting benefit-cost calculations, other problems remain. Some examples follow (see also Behrman et al. 2004; Behrman and Kohler 2011):

1) *Range of Impacts*: As we have highlighted above, family planning programs and reduced fertility are likely to have a range of impacts. On the micro-level, these impacts are potentially incurred by individuals, their families, and their offspring and/or parents. On the macro-level, these impacts may include economic development, which we will consider as part of the assessments in this paper, but also aspects such as climate change, political instability and conflict, which are not considered here due the lack of detailed empirical studies that could inform benefit-cost evaluations in this domain.

2) *"Prices"*: Impacts generally are multiple and measured in different units, but must be combined into the same units (normally monetary units with prices as weights) in order to sum them and in order to compare them with costs. For some impacts conceptually at least the measurements are relatively straightforward—for instance, market prices for the value

of increased labor productivity or reduced use of medical goods and services under the assumption that such prices reflect the true social marginal value of the relevant good or service. But for other impacts, this evaluation is much more challenging. The key example for this project is the value of averting mortality. A range of methods have been proposed in the literature—for example, the lowest-cost alternative means of averting mortality (Summers 1992, 1994) and the revealed preference as reflected in wage-risk choices in labor markets (Aldy and Viscusi 2007; Hammitt 2007; Robinson 2007; Viscusi 1993, 2010). A related question is what prices should be used. For example, should prices (including wages) be used for a poor SSA developing country or for Denmark—under the argument that a life should be valued the same whether it be in a low- or a high-income country? How these questions are answered can make an enormous difference for the present project in which averted mortality is a major impact. For example, Summers (1992) reports that the cost of saving a life through measles immunization was on the order of magnitude of \$800 per life saved in the early 1990s or about \$1250 in 2004 (adjusting for inflation and the costs of raising resources Behrman et al. 2004), while in a recent publication Bartick and Reinhold (2010) use \$10.56 million per death in 2007 US dollars. For the present project, all of the Assessment Papers are using the same two alternatives—DALYS of \$1,000 per year and \$5,000 per year—to assure consistency within the project with regard to this critical assumption.

3) *Range of costs*: What is of interest for the costs are the total true resource costs to society. These are not identical to governmental budgetary expenditures, though often analysts seem to assume that they are. On one hand governmental budgetary expenditures in some cases include substantial transfer components (e.g., in Conditional Cash Transfer programs), which typically involve some but much smaller resource costs than the amount of the fiscal expenditures. On the other hand, private costs and distortionary costs of raising funds for governmental programs may be considerable. Many programs, for example, may require time inputs from individuals that are not typically covered by governmental expenditures. Distortion costs of raising resources for governmental expenditures also have been estimated to be on the order of magnitude of 25% of those expenditures or more (e.g., Ballard et al. 1985; Devarajan et al. 1997; Feldstein 1995; Harberger 1997; Knowles and Behrman 2003, 2005). Because cost estimates vary considerably, it is important to present estimates that illustrate how robust the benefit-cost ratios are to different cost estimates.

4) *Discounting*: The costs and, probably even more the benefits, may be distributed over a number of years. But the value to society of resources in the future is less than the value of the same resources now because they can be reinvested if they are available now. Therefore future costs and benefits should be discounted to the present for comparability, particularly for costs and benefits that are likely to occur some time into the future. And the discount rate makes a difference. For instance, the present discounted value (PDV) of \$1,000 received in 20 years is \$553 if the discount rate is 3%, \$377 if the discount rate is 5% and \$149 if the discount rate is 10% (and for 40 years, the respective PDVs are \$306, \$142 and \$22). However there is a lack of agreement about what discount rates are appropriate, though rates in the 3%–10% range are common for the social sectors. For the present project, all of the Assessment Papers are using the same two alternatives—discount rates of 3% per year and 5% per year—to assure consistency within the project with regard to this critical assumption.

5) *Interactions among policies*: Of necessity we consider family planning programs in isolation. But clearly, these programs are often embedded in other policy interventions (such as programs targeting the HIV/AIDS epidemic in SSA), and even if they are not explicitly integrated in such programs, the impact of family planning programs will likely depend

on policies that affect access to health care and/or schooling. The policies will also depend on social and economic institutions, as the extent to which such institutions changes as a result of either the development process itself or specific policy interventions. Hence, variation across countries with respect to institutional and policy contexts is likely to have substantial implications on the consequences of scaling up family planning programs—but little systematic knowledge exists that would allow the incorporation of these aspects in the benefit-cost calculations pursued here.

6) *Value of lives not born*: Family planning programs, through their effect of fertility, affect the size of the population. This of course gives rise to the question on how to consider the welfare of persons who may not be born as a result of the intervention—a question that has been notoriously difficult to answer and for which no consensus exists in the literature (for discussions of this issue, see for instance Golosov et al. 2007; Razin and Sadka 1995). In our analyses, we follow Ashraf et al. (2011) and related studies and will not consider in the evaluation of family planning programs the welfare of individuals who are not born as part of the program.

7) *Scale*: Scale can come into estimation of benefit-cost ratios in at least four ways. First, there may be high benefit-cost interventions that are effective for only a small select population, and therefore are not likely to be of interest for the present project with its broad perspective. Second, there may be interventions that have high benefit-cost ratios on a small scale but that are difficult to scale-up because critical dimensions of the small-scale intervention (e.g., high-quality and particularly dedicated staff) cannot be maintained if the intervention is scaled-up. Third, there may be important aggregate effects that result from reduced fertility due to family planning programs, including important aggregate impacts on economic growth. Family planning programs that are implemented on a large—possibly national or even regional—scale can potentially affect population dynamics, and through the effects of reduced population growth and changes in age structure, can affect economic development and individual incomes. Programs that are implemented on a smaller scale, however, are unlikely to affect aggregate population dynamics, and any feedback from aggregate population change on the benefits resulting from family planning program is likely to be absent or minimal. In addition, effects of reduced fertility on the incentives to invest in child schooling or health may depend on the scale of the program, and the fraction of the population that is reached by family planning programs. In our analyses, we will focus on fairly large scale comprehensive programs that have implications on both the micro and macro level. And while detailed analyses of how the scale of programs affects the benefits (and possibly costs) resulting from such program seem impossible given the state of the literature, it is important to acknowledge the scale of programs in interpreting the results.

7) *Estimation challenges*: The estimation challenges for obtaining benefit-cost ratios are enormous not only for the reasons noted above, but because of the difficulties in obtaining good response estimates due to endogenous behavioral choices, unobserved variables, selectivity of samples, and different market and policy contexts to which large numbers of academic studies have been devoted. Our above review of the literature reflects these uncertainties. For example, for many family planning programs, both program effects and the costs associated with potentially effective programs are difficult to pin down, and scaled-up programs may have different effects and be subject to different costs than programs that have been implemented as part of research studies. Moreover, an important body of evidence stems from one specific program, the Matlab family planning in Bangladesh, that was relatively expensive relative to GDP per capita and the findings of which may nor may not translate to other contexts. One could therefore conclude that the task of estimat-

ing benefit-cost ratios is so difficult that it would be better to abandon it. But that would leave society with little systematic guidance about policy choices in this important area. Therefore, in hopes of improving the basis for policy guidance, we swallow hard and proceed boldly and hopefully creatively (and hopefully not too foolhardily) to make the best estimates that we can given the present very imperfect information and strong assumptions necessary, with some efforts to explore the sensitivity of our estimates to important alternative assumptions.

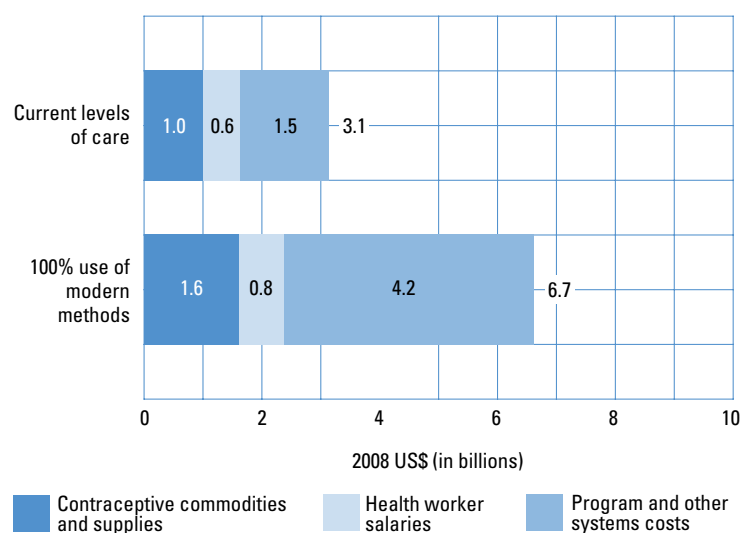
6. BENEFIT-COST ANALYSES FOR POLICIES TARGETED AT REDUCING POPULATION GROWTH

6.1. Costs of Contraception and Family Planning Programs

Several recent studies provide estimates of the costs of expanding family planning programs and contraceptive services in developing and high fertility countries. Evaluations of family planning programs during the 1980s have estimated the costs per averted birth in developing countries ranging from around \$45 (Philippines, Jamaica, Thailand, Sri Lanka) to \$260 (Latin America and the Caribbean), with some estimates being higher (reported in Pritchett 1994, and converted to 2010 USD). Levine et al. (2006) estimates costs of birth averted that range from \$87 in Latin America and the Caribbean to \$131 in sub-Saharan Africa and \$163 in East Asia and the Pacific (all 2001 USD).

Because recent research has demonstrated the broader implication of family planning programs for health and economic outcomes (see Section 3.4), the recent literature on family planning de-emphasizes the costs per birth averted and focuses on the costs of service and cost of different health outcomes associated with family planning programs (see below). For example, some estimates of the costs of family planning programs focus on satisfying the demand for contraception as indicated by unmet need. Estimates by the Guttmacher Institute suggest that of the 818 million women who want to avoid a pregnancy (in 2008), 603 are using modern contraceptives and 215 million are not and are considered as having unmet need (Singh et al. 2010). The majority of women with unmet need are estimated to live in sub-Saharan Africa. Figure 12, obtained from this Guttmacher Institute report, shows that the current annual cost of providing modern family planning services to 603 million users in the developing world was about \$3.1 billion (about \$5 per women using family planning), including costs of contraceptives and related supplies, labor costs of health workings and program and other public health systems costs. These services are paid for by a combination of domestic sources including taxes and private sector contributions, employer and employee contributions to health insurance, and out of pocket payments by service users. Expanding family planning services to all women with unmet needs—a total of 215 million women—would require an additional annual expenditures of \$3.6 billion, bringing the total to \$6.7 billion annual. 75% of these additional expenses would be required for program and other systems costs related to expanding family planning services, while only 16% would be required for the supplies and contraceptive commodities.¹⁷ Based on these estimates, the per-person costs of expanding service to women with unmet needs in developing countries is close to \$17, more than three times the costs as for current users of family planning services. These costs are broadly consistent with estimates for a sub-Saharan context (Kenya) (Figure 13) (USAID Health Policy Initiative 2010) that range from \$2.74 (IUD) to \$13.42 (implant) per couple-year of protection. Costs

¹⁷It is difficult to assess based on Singh et al. (2010) and related reports how quickly, if at all, programs could be family planning programs could be expanded to reach the unmet need of *all* women in the developing world or SSA, even if the additional funds were provided.



Notes Estimates are for 2008 for all developing countries. Components may not add up to totals because of rounding. "Current levels of care" meet only part (74%) of existing need for modern family planning. "100% use of modern methods" meets all existing need for modern family planning. Program and other systems costs include costs for program management, supervision, training of personnel, health education, monitoring and evaluation, advocacy, information systems and commodity supply systems, and costs for maintaining and expanding the physical capacity of health facilities.

Figure 12: Cost of providing family planning services in developing countries

Source: Singh et al. (2010)

at NGO facilities are estimated to be somewhat higher. Increasing the contraceptive prevalence of modern methods by 1 percentage point during one year in Kenya—from 39.5% (2008) to 40.4%—requires an additional 97,200 users (accounting for population growth) and is estimated to require expenditures of about \$1.4 millions in terms of commodities and personnel (given current distribution of family planning methods), or about \$14 per additional user. The costs are estimated to be considerably higher per additional user if the contraceptive prevalence were to be increased by about 20 percentage points as such an increase would require substantial additional investments in health service infrastructure that is not required for a more modest increase of only 1 percentage point (for a recent discussion of the health systems strengthening efforts that are required for the implementation of successful family planning programs, see Population Council 2012, Ch. 3).

It is also important to emphasize that a mere improvement in supply of and access to family planning is unlikely to be adequate to achieve significant changes in family planning use, and the concept of unmet need is correctly criticized for suggesting this (Bongaarts and Bruce 1995; Lam 2012; Pritchett 1994). In addition to supply-side factors, the reasons for the non-use of family planning often include fears about side effects, husband/familial disapproval, or lack of information/knowledge about contraception and/or the benefits of reduced fertility (Sedgh et al. 2007; see also Section 3.4). Peer pressures and social network influences can also be important factors resulting in non-use (Kohler et al. 2001; Lyngstad and Prskawetz 2010). And, of course, the level of desired fertility—which the notion of unmet needs takes as a given—can be targeted by policies that affect the costs and/or benefits of children or the costs of fertility regulation (Easterlin and Crimmins 1985; Pritchett 1994; Schultz 2007). Hence, in order to be effective, family planning programs often in-

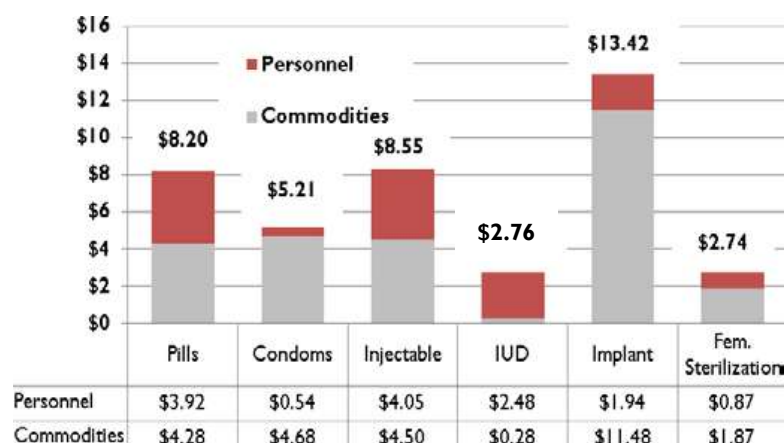


Figure 13: Cost of providing family planning services in Kenya (government clinics) per couple-year of protection

Source: USAID Health Policy Initiative (2010)

clude *demand generation* through media campaigns and related behavior change communication in order to stimulate and/or motivate individuals to desire birth spacing or limiting, seek out family planning services and adopt contraceptive method use (Population Council 2012, Ch. 4). Interpersonal communication through community leaders, health workers and has been shown to be an important aspect contributing to the effectiveness of family planning programs (Arends-Kuenning 2001; Freedman and Takeshita 1969; Munshi and Myaux 2006; Phillips et al. 2006; Sunil et al. 1999; Valente and Saba 1998), as are program designs that increase women's autonomy in contraceptive decision-making (Ashraf et al. 2010). Several studies have also documented the effects of media campaigns and related behavioral change communication on the adoption of contraception and family planning (Freedman 1997; Jensen and Oster 2009; La Ferrara et al. 2008; Valente and Saba 2001), which is expected based on emphasize the diffusion of innovation and social interactions (Bongaarts and Watkins 1996; Cleland and Wilson 1987; Kohler 2001; Montgomery and Casterline 1996). Based on the existing literature, however, the costs of these components of family planning programs are difficult to assess in general and are likely to be relatively country-specific. Rather than trying to account for these costs directly, we conduct in our concluding section sensitivity analyses that document the robustness of our benefit-cost ratios with respect to a potential underestimation of program costs.

A different approach of assessing the costs of family planning is taken by Moreland et al. (2010), who try to estimate the family planning implications of the different UN projection scenarios (see Section 2).¹⁸ The (undiscounted) cumulative family planning costs for the 45-year period between 2005–50 for sub-Saharan is estimated to be \$178 billions for the median variant (Figure 7), with costs ranging from \$156 billions for the high fertility variant and \$198 billions for the low fertility scenario (the present value of family planning costs, discounted at 4%, are \$60.7 billions (medium variant), \$68.4 billions (low variant) and \$52.6 billions). The costs include commodities and personnel costs, but not necessarily the costs of scaling up the health systems to facilitate the service provision for these scenarios. Three aspects of these estimates are particularly noteworthy: first, the con-

¹⁸Moreland et al. (2010) base their calculations on the 2008 version of the UN World Population Prospects, rather than the most recent 2010 version. The differences of assessing the costs of family planning programs between these versions are likely to be minor.

traceptive costs of achieving the any of the three UN scenario are fairly substantial, with the discounted family planning costs for the 45-year period (excluding health systems cost such as potentially required expansions of the health care system; see Population Council 2012 Ch. 3 for a discussion) corresponding to about 6% of the sub-Saharan annual GDP. Second, the difference in discounted family planning costs between the UN high and low scenario is about 30%, corresponding to a difference in 2050 projected SSA population of about 478 millions and a difference in the 2005–50 population growth rate of .58 percentage points (between the 2.24% growth rate during 2005–50 in the high and the 1.66% growth rate in the low fertility scenario). Third, based on the difference in UN population projections for 2050, an averted birth during the period 2005–50 corresponds to family planning costs of \$32, and a reduction in the 2050 sub-Saharan Africa population of 1 person entails discounted family planning costs of about \$33. Or stated differently, by extrapolating these numbers, a reduction in the population growth rate by 1 percentage point during 2005–50 would entail discounted family planning costs of about \$27 billion (or about 3% of current SSA GDP).

Rather than estimating family planning costs based on the commodity and personnel costs required for attaining specific fertility trajectories, such as the UN median scenario (see above), it is also informative to consider costs of past family planning programs. The Matlab family planning experiment (see Section 3.4) is widely considered to have been fairly expensive (and was thus potentially financially unsustainable), with annual program expenditures of about 10% of per capita GDP per fertile woman; in contrast, the Profamilia program in Colombia had program costs of about .1% of GDP per capita (or about 1/100th of the Matlab cost relative to income) (Miller 2010; Pritchett 1994). The reasons for these large differences in program costs are not fully transparent; they are possibly related to the fact that the Matlab program was explicitly established to evaluate a best-practice family planning program in a resource-poor context, with considerable resources devoted to the program implementation and the development of the relevant infrastructure; the Colombian family planning program, on the other hand, built on existing health infrastructure within a more developed context (and higher initial per capita GDP).

6.2. Benefits I: Reduced Expenditures on Health, Schooling, Etc.

The benefit of family planning programs has often been assessed in terms of savings on social programs as a result of a less rapidly growing size of birth cohorts, with savings including a reduced need for expanding the school system, providing education, implementing immunization programs or providing health care for children. Family planning program also reduces costs of maternal health programs or programs to provide water and sanitation due to less rapid population growth. In a recent policy brief on *“What would it take to accelerate fertility decline in the least developed countries?”*, the UN estimates that *“for every dollar spent in family planning, between two and six dollars can be saved in interventions aimed at achieving other development goals”* (UN Population Division 2009; based on calculations in Bernstein 2006). A related report for Kenya (Figure 14), under the heading , estimates that family planning expenditures of \$71 million during period 2005–15 are associated with social sector cost savings of \$271 millions—a benefit-cost ratio of close to 4:1 (USAID Health Policy Initiative 2009b). Corresponding estimates in the literature vary widely. For example, due to smaller costs associated with satisfying the demand for unmet needs, USAID Health Policy Initiative (2009b) estimates a ratio of social cost savings for each dollar spent on family planning of 13 to 1 for El Salvador, and a 1984 study estimated of costs savings in government programs of up to \$16 for each dollar spend on family planning programs in Thailand for the period 1972–2010 (the ratio is 7:1 for the first nine years of the program)

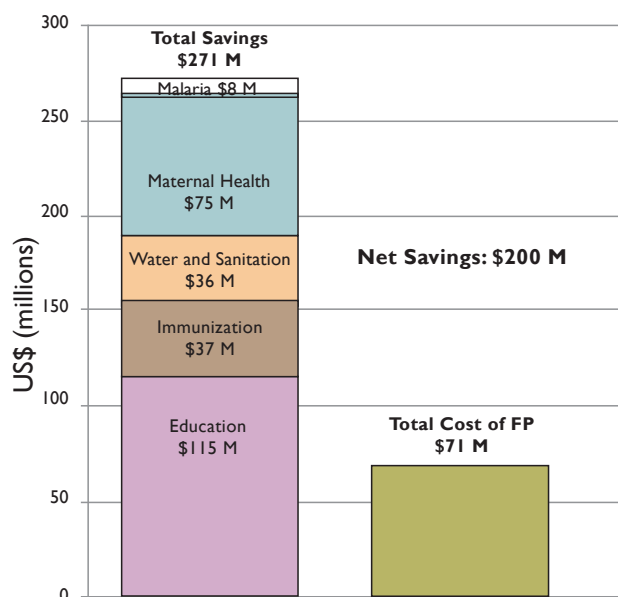


Figure 14: Social Sector Cost Savings and Family Planning Costs in Kenya, 2005–2015

Source: USAID Health Policy Initiative (2009b)

(Chao and Allen 1984).

Estimates along the above lines are frequently used to argue that “*Family planning is a good investment*” (Bongaarts and Sinding 2011a; UN Population Division 2009; USAID Health Policy Initiative 2009b) because social cost savings as a result of reduced fertility and improved health outcomes significantly exceed the expenditures on family planning programs. However, it is important to note that the estimates of these social cost savings mostly result from “*accounting*” for lower fertility and improved health outcomes; these estimates do generally not reflect that reduced fertility may result in shifts from child quantity to child quality, which is likely to increase demands for schooling and potentially other health services. Hence, the social costs savings highlighted in Figure 14 and relates studies may be misleading in terms of reductions in social costs if family planning programs also result—as is suggested by much of the recent literature—in shifts in the demand for child quality (including for instance child health and schooling) (Section 3.2).

6.3. Benefits II: Evaluating Reduced Infant and Maternal Mortality

The recent research and policy literature on family planning emphasizes the positive reproductive health outcomes associated with increased availability of contraceptives that allows women and couples to satisfy unmet need (Cleland et al. 2012). Table 3, for example, reports findings from the above-mentioned Guttmacher Institute report (Singh et al. 2010), arguing that in 2008 modern contraceptive use prevented 188 million unintended pregnancies, 1.2 million newborn deaths, and 230,000 maternal deaths and other negative health outcomes that would have occurred in the absence of any modern method use. According to this report, expanding family planning programs so that (current) unmet need were fulfilled would result in 640,000 fewer newborn deaths, 150,000 fewer maternal deaths (more than 50,000 fewer from unsafe abortion and more than 90,000 fewer from other pregnancy-related causes), and 600,000 fewer children who lose their mother. The report also estimates that satisfying unmet need results in 36 million fewer healthy years

Table 3: Benefits resulting from modern contraceptive use among women who want to avoid a pregnancy, according to contraceptive use scenario, 2008*Source: Singh et al. (2010)*

Measure (000s)	Current use of modern methods	Fulfillment of unmet need for modern methods	Total
Unintended pregnancies averted			
Unplanned births	187,800	53,460	241,260
Abortions	53,550	21,820	75,370
Miscarriages	112,310	24,800	137,100
	21,940	6,840	28,780
Deaths averted			
Newborn	1,170	640	1,810
Maternal	230	150	380
Children who would not become orphans	740	600	1,340
DALYs saved			
Women	24,640	12,430	37,070
Newborns	46,350	23,710	70,060
No. contraceptive users	603,090	214,450	817,540

of life lost (12 million fewer among women and 24 million fewer among newborns) (for related analyses, reaching generally similar conclusions, see Ahmed et al. 2012). In a related study, Ross and Blanc (2012) decomposes declines in maternal mortality into the contributions resulting from changes in the numbers of women, the number of births, and fertility rates, concluding that declines in fertility averted approximately 1.7 million maternal deaths in developing countries during 1990–2008, corresponding to a 54% reduction in the maternal mortality rate. Relating fertility declines to changes in contraceptive use, Cleland et al. (2012) argues—with some leap of faith in terms of inferring causal relationships from observed associations—that, because increased contraceptive use accounts for 73% of the fertility decline, about 40% in the reduction in the maternal mortality rate is due to contraception. In analyses that control for potential confounders, Cleland et al. (2012) furthermore estimate that for each percentage point increase in contraceptive use, the maternal mortality rate decreased by 4.3 deaths per 100,000 births. Analyses of Demographic and Health Survey data furthermore suggest that about one third of maternal deaths in developing countries is preventable if the unmet need for family planning were satisfied and all women wanting to stop childbearing used effective contraception (Collumbien et al. 2004; Singh et al. 2010). Nevertheless, this progress in reduced maternal mortality—both in terms of risk per birth and the total number of maternal deaths—has occurred relatively unevenly within developed countries. For example, Ross and Blanc (2012) point out that, to date, SSA has experienced minimal declines in maternal deaths, resulting from the combined effect of increases in the number of women at risk and small declines in fertility and mortality. In addition to reducing maternal mortality, increased contraceptive use has been associated with reduced infant mortality, primarily as a result of reducing the frequency of

relatively short birth intervals (Hobcraft et al. 1984; Rutstein 2005) and better child health outcomes (Dewey and Cohen 2007). Cleland et al. (2012) conclude based on a review the existing literature that the infant mortality rate would fall by about 10%, and mortality of children aged 1–4 by about 20%, if all children were spaced by a gap of at least two years.

Given the fact that some empirical evaluations of family planning programs have documented effects of these programs on infant mortality (e.g., Joshi and Schultz 2007), but not in all cases where the effect on mortality was investigated (e.g., Miller 2010), it is difficult to evaluate if these specific assumptions about positive reproductive health outcomes from contraceptive use and satisfying unmet need in the above studies are realistic and reflect causal estimates of family planning programs (Section 3.4) rather than merely observed associations. Skeptical readers of the above evidence are likely to be worried that the above analyses of the number of maternal and infant/child death averted as a result of increased contraceptive use are overestimates since they are mostly derived from correlational studies that may not necessarily provide estimates of causal effects (for a discussion of these estimation issues, see Schultz 2010). Nevertheless, the recent economic literature on the careful evaluation of family planning programs reviewed in Section 3.4, suggests a relatively convincing basis for concluding that positive health benefits for children and mothers of family planning programs do indeed exist, and that these positive effects persist after controlling for possibly endogeneity of contraceptive use. But these micro-studies are difficult to generalize to SSA or all developing countries for obtaining benefit-cost ratios. Hence, while acknowledging the potential limitations of these estimates for the benefit-cost analyses in this paper, we take the estimates in Singh et al. (2010) at face value, and evaluate the value of life according to the Copenhagen Consensus 2012 guidelines with \$1,000 per DALY, 3% discounting and life expectancy at birth (for newborn deaths) and at age 28 (for maternal deaths). In this case, the expansion of family planning programs to cover current unmet need in developing countries results in total benefits of \$110 billions. Given costs of satisfying the current unmet need of \$3.6 billion, these calculations suggest a benefit-cost ratio of about 30:1 for the expansion of family planning programs to cover unmet need. This benefit cost ratio rises to 50:1 if the DALYs saved reported in Table 3 are valued at \$5,000, and the benefit-cost ratios would even be higher if the average costs of service provision, rather than the marginal costs of satisfying unmet need, were used in the calculations. However, these benefit-cost ratios are overestimates to the extent that the causal impacts of family planning programs are less than those estimated in Singh et al. (2010) and assumed in the above calculations.

6.4. Benefits III: Life-cycle, distributional and intergenerational benefits of family planning programs

In addition to the effect of family planning programs towards reducing fertility and reducing maternal/child mortality, these programs have been shown to result in higher levels of female (mother's) education, improvements in women's general health (e.g., as indicated by BMI) and longer-term survival, increases in female labor force participation and earnings, increased child health (up and beyond the effect on reducing child mortality) and increased child human capital (including higher schooling levels) (e.g., Joshi and Schultz 2007; Miller 2010; Schultz 2009; see Section 3.4 for a detailed discussion). Several of these program effects will affect individual's well-being because in large-scale family planning programs—the only ones that we evaluate here—these effects will make contributions to economic growth, which in turn will affect future income levels. The benefits resulting from increased economic growth—including (at least partially) the effects of improved health, human capital, female labor force participation and higher female earnings—will

be considered in the next section. In addition, all of the above program effects will generally be considered desirable and beneficial because they reduce inequality, including gender inequality, contribute to an improved status of women, possibly reduce poverty, and potentially increase subjective well-being among adults (and especially females) and children. Nevertheless, within the current framework and given the available empirical evidence, it will be impossible to explicitly evaluate the benefits of these effects in terms of our benefit-cost calculations up-and-beyond their contributions to economic growth that are considered below.

6.5. Benefits IV: Contributions of reduced fertility on per-capita income growth

The macro-level interactions between population growth and economic developments are among the key considerations in evaluating the potential benefits of investments in family planning programs. But despite decades of research on this topic with shifting consensus opinions (see Section 3.3), this aspect remains challenging to evaluate. We review, and then evaluate, in this section some of the prevailing perspectives. It is important to keep in mind that, even if we conclude below that benefit-cost ratios of family planning programs are likely to be significantly larger than one with respect to contributions to per-capita income growth, one should not have illusions about the ability of such programs to reduce global inequalities in income levels between developed and developing countries, or even between the least and other less developed countries. The contribution of reduced population growth to economic growth, pale in light of the about 20-fold differences in income levels that exist in global comparison. Hence, family planning program are not likely to be a substitute for other development efforts.

To start the discussion of the potential benefits of family planning programs and reduced fertility in terms of economic growth, we initially focus on arguments made by policy-oriented organizations advising SSA governments, NGOs and international donors such as USAID. For example, to assess the potential contributions of reduced fertility on per-capita income growth, the USAIDS-funded Health Policy Initiative (<http://www.healthpolicyinitiative.com/>) that has developed a a computer-based tool RAPID (USAID Health Policy Initiative 2009c). This tool allows stakeholders to “*demonstrate the effect of rapid population growth on different sectors and the benefits of [family planning] programs*”. The description of the program states: “*The model combines socioeconomic indicators—such as labor force participation, primary school enrollment, and number of nurses per capita—with demographic information and population projections to estimate impacts up to 30 years into the future. Different scenarios are projected so that policymakers can compare the consequences if the country/region continues to have high fertility vs. the benefits of reducing fertility, in part, through [family planning] programs.*” In recent publications, in collaboration with the respective governments, this model has been used to assess the contributions of population and family planning programs to development in several low income countries, including Kenya, Malawi, Uganda and Zambia (Government of Kenya 2010; Government of Malawi 2010; Uganda Ministry of Finance, Planning and Economic Development 2010; Zambia Ministry of Finance and National Planning 2010). Figure 15 illustrates differential per capita GDP growth associated with differential fertility rate in RAPID model, indicating that the low fertility scenario results in an almost 40% higher GDP per capita in 2037 as compared to the high fertility scenario. In the low fertility scenario, per capita GDP per capita grows by 3.6% p.a., compared to 2.5% in the high fertility scenario. The per person net present value of this increased per capita GDP is close to \$1,500, and using earlier estimates of the family planning investments required to achieve the reduced fertility (Section 6.1), the benefit-cost ratio in the order of magnitude of 60:1 as a result of increased GDP per capita alone. The USAID

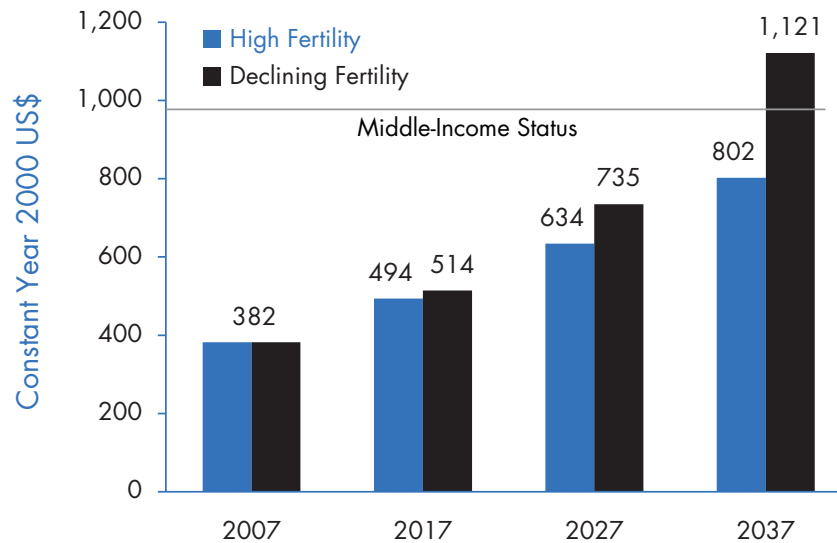


Figure 15: RAPID model simulation: Zambia GDP per capita as a function of fertility trends based on 6% aggregate economic growth rate

Note: The high fertility scenario assumes a modest decline of the total fertility rate from 6.2 in 2007 to 5.8 in 2037; the low fertility scenario assumes a decline to a TFR of 2.2.

Source: Zambia Ministry of Finance and National Planning (2010)

Health Policy Initiative report therefore concludes, consistent with these high returns to investments in family planning during the next decades, that “[t]he *Zambian vision to become a middle-income country can best be achieved by a combination of fast economic growth and a slower rate of population growth*”. Very similar conclusions are attained in USAID Health Policy Initiative reports for other higher fertility low income countries (Government of Kenya 2010; Government of Malawi 2010; Uganda Ministry of Finance, Planning and Economic Development 2010; Zambia Ministry of Finance and National Planning 2010).

If the analyses and the interpretation that are illustrated in Figure 15 in the case for Zambia are correct, the adoption of a family planning program would result in significant economic gains in terms of a more rapid growth of income resulting from reduced fertility. However, how is this more rapid growth of GDP per capita achieved, and is it broadly realistic? Reading the underlying documentation of the RAPID model reveals:

“The effect of rapid population growth on economic growth depends on a number of factors. It has been difficult for those who study it to find unambiguous connections because many of the factors that influence economic growth vary across countries just as population growth rates do. The variety of issues [has been] examined by the National Research Council in a 1986 study (National Research Council 1986). [...] Since many of these issues are too complex to treat in a short policy presentation, the RAPID model uses only relationships that are well understood and easy to describe. The basic model focuses on three basic concepts: dependency, the requirement for new jobs and per capita output.” (USAID Health Policy Initiative 2009a, p. 13)

In terms of modeling assumptions, this implies that the rate of aggregate GDP growth is assumed to be independent of population growth—and set to 6% for the calculations shown in Figure 15. As a result, reductions in the rate of population growth directly translate into increases per capita income, and while GDP per capita differs, both fertility scenarios in Figure 15 assume and identical aggregate GDP. Moreover, while the documentation

reflects the considerable uncertainty surrounding the assumption about the interaction between economic growth and population growth, the above-cited documents targeted at policy makers (Figure 15) present a much more clear-cut connection between reduced population growth and more rapid per capita income growth.

In light of recent research on the interaction between population growth and economic growth (see Section 3.3), how realistic are the calculations in Figure 15 and related reports about the economic returns (measured in terms of GDP per capita growth) of reduced fertility and investments in human capital? Are there reasons to believe that benefit-cost ratios in the order of 60:1 are realistic in the area of per capita GDP growth over several decades?

In order to shed light on this question, the linkages between economic growth and changes in the population size and structure needs to be made explicit. One possible approach is provided by Ashraf et al. (2011), who revisit the above question about the extent to which economic measures such as GDP per capita would change in response to reductions of fertility. Specifically, the model tries to account for four different effects through which population size and age structure may affect economic growth (see also Section 3.3). The first two focus on the role of the population size: a *Malthusian effect*, reflecting the the congestion of fixed factors, such as land, through population growth; a *Solow effect* that captures the capital shallowing resulting from a growth in the labor force. In addition, several channels reflect potential effects of changes in the age structure the population and capture potential demographic dividends (see also Section 3.3): a *dependency effect* that captures that, in a high-fertility environment, a reduction in fertility leads, at least temporarily, to a higher ratio of working-age adults to dependents and—if income per worker is held constant—mechanically raises income per capita; a *life-cycle savings effect* that captures that a concentration of population in their working years may raise national saving, feeding through to higher capital accumulation and higher output; an *experience effect* that captures the shift of the working age population to higher ages, i.e., towards individuals with more experience and potentially higher productivity; a *life-cycle labor supply effect* reflects that labor force participation may increase as a result of differential participation rates when the age structure shifts to older ages, and a *child care effect* reflects increases in female labor supply as a result of reduced fertility; finally, a *child quality effect* reflects that reductions in fertility may result in a quality-quantity trade-off, and increased child quality may foster economic growth. The model does not include one additional potential effect, a *Boserup effect* that would capture direct effects of the population size on productivity, for instance through economies of scale or induced institutional change.

Figure 16 shows the results for the development of GDP per capita (light blue line) along with some related indicators for two scenarios: First, an immediate decline of the TFR by 1 (from 5.32 to 4.32) that is compared to the TFR remaining constant at the 2005 level of 5.3. Second, a future trend of the TFR that follows the UN low scenario as compared to the medium scenario, resulting in a 12% smaller population as compared to the medium scenario. The surprising result from the simulations in Ashraf et al. (2011), which are based on an explicit economic model that includes interactions between economic development and the size and age-structure of the population—is that the findings are very consistent with the conclusions obtained from the RAPID model reviewed above (see also Figure 15). In the top panel of Figure 16, GDP per capita is about 26% higher after 50 years if the TFR declines by one child as compared to constant fertility. Since the population size is also about 25% lower in this case as compared to the constant fertility scenario, over the course of 50 years the more rapid growth in GDP per capita after a decline in TFR essentially mirrors the less rapid growth in the size of the population. A similar conclusion

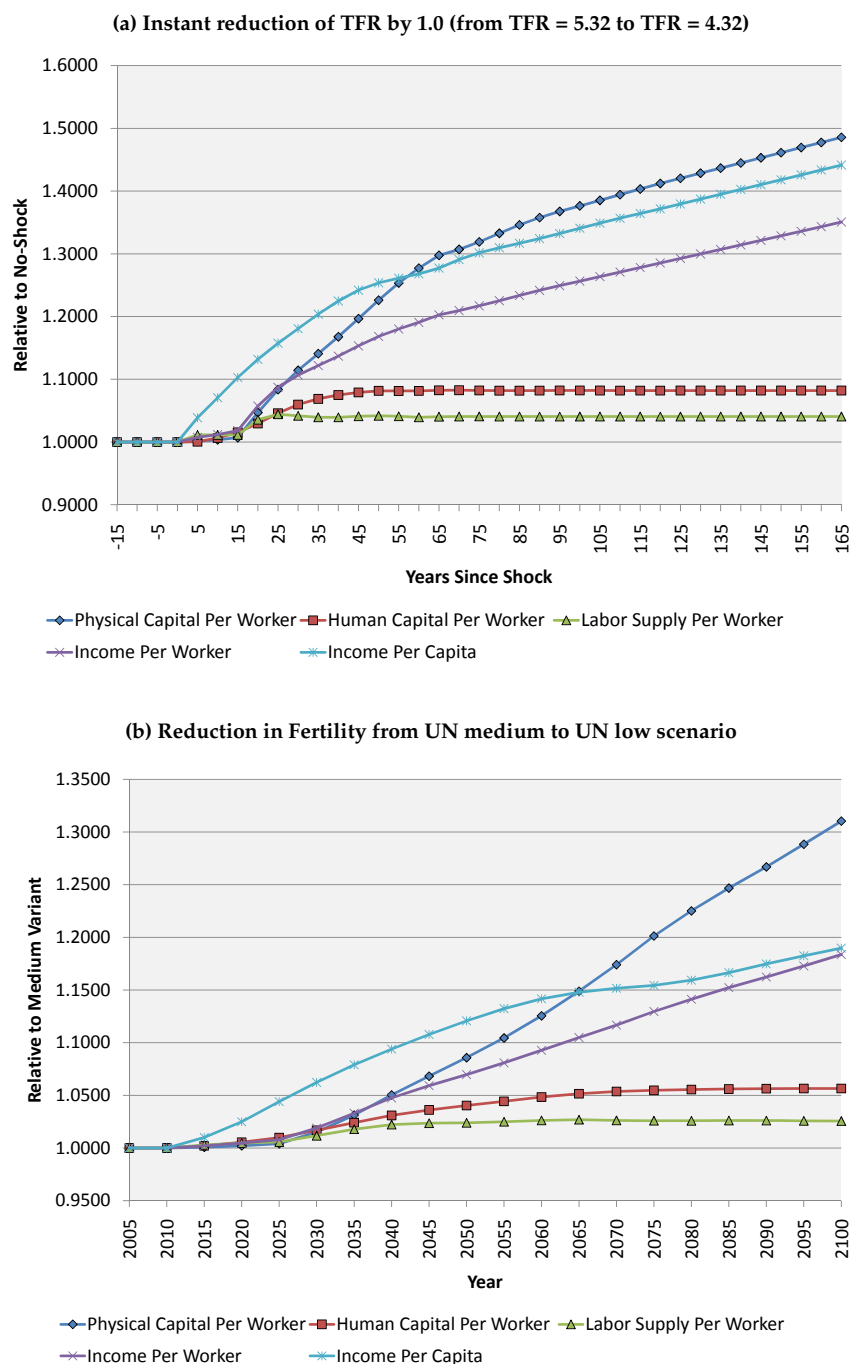


Figure 16: The effect of reduced fertility on economic growth in a unified growth model calibrated to Nigeria.

Notes: Top panel: Instant reduction of TFR by 1.0 (from TFR = 5.32 to TFR = 4.32); after 50 years, the population is 25% smaller than under constant fertility. Bottom panel: Reduction in Fertility from UN medium to UN low scenario; by 2050, the population in the low fertility scenario is 12% below that of the medium scenario.

Source: Ashraf et al. (2011)

follows from the simulations that compare the UN low fertility scenario with the UN median fertility scenario. In the low fertility scenario, the population in 2050 is about 12% below that implied by the medium scenario. The simulations in Ashraf et al. (2011) associate with this less rapid growth in population a 12% higher GDP per capita (Figure 16, bottom panel). In summary, therefore, the analyses by Ashraf et al. (2011) suggest that, across two simulations with very different population and economic growth rates, an approximate calculation in which reductions in population growth rate increase growth in GDP per capita almost one-for-one is fairly accurate over a 50 year horizon.¹⁹ And while the analyses by the USAID Health Policy Initiative using the RAPID model (see above) can be correctly criticized for not having an explicit economic model that informs the contribution of demographic changes to economic growth, the conclusions in Figure 15 (and related country studies) about the connection between reduced population growth and higher per capita GDP are remarkably consistent with the analyses by Ashraf et al. (2011) (Figure 16). If this were indeed the case, the benefit-cost ratios in terms of GDP per capita would be on the order of magnitude of 60:1 over a 50 year horizon—as we’ve calculated above for Zambia—if reducing the population growth by 1% during this period would have present per capita value costs of around 20–30% of per capita GDP—an assumption that seems quite plausible given the calculation of family planning program costs above.²⁰

In addition to relying on results of simulation models such as in Ashraf et al. (2011), we can ask if our knowledge of the interactions between population growth and economic development, and in particular, our knowledge of the potential impacts of changing ages structures, are consistent with the above interpretations (Bloom and Canning 2008; Bloom et al. 2007a,b, 1998; Kelley and Schmidt 2005; Kelley 1995) (see also Section 3.3). Eastwood and Lipton (2011) provide a detailed discussion of the implications of this literature for understanding the potential of a demographic dividend in sub-Saharan Africa. In particular, the recent literature on the demographic dividend has estimated versions of models of the form $g(Y/N) = \phi + X\beta + \delta(Y/L) + \gamma g(WA/N)$, where $g(\cdot)$ denotes the growth rate, Y is output, N is the population size, L is the size of the labor force, Y/L is output per worker, (WA) is the population in working ages, and WA/N is the fraction of the population in working ages. γ indicates the effect of changes in age in the proportion of the population in working ages—which tends to increase as fertility declines—on per capita income. Estimates for γ range from 1.5 to 3.5, with the higher of these figures obtained for African countries (e.g., Bloom et al. 1998, Table 6). Are these estimates possibly consistent with an interpretation such as in Figure 15 (and also Figure 16) that reduced rates in population growth almost one-for-one translate into increased per capita growth?

For Zambia, for example, the projected population growth rate during 2010–60 is 3.29% in the UN high fertility scenario, and 2.73% in the UN low fertility scenario; the low fertility scenario thus implies a .56 percentage point lower growth rate. In the high fertility scenario, the growth in the fraction of the population at working ages (16–65) is 0.121%, and in the low fertility scenario this growth rate increases to 0.292% (a difference of .171

¹⁹We emphasize that these calculations are “approximate” in the sense that there is considerable uncertainty about this conclusion. While the model Ashraf et al. (2011) is based on the most recent developments in growth theory (see Section 3.3) that is calibrated to a SSA context, an assessment of the aggregate consequences of fertility declines based on remains subject to important uncertainties about the parameter values used in the simulation as well as about the mechanisms for the interactions between population change and economic development that are postulated as part of the model.

²⁰The calculation assumes that GDP per capita grows at 3–4% p.a., and that a reduction in population growth would increase the rate of GDP per capita growth by 1 percentage point. The gain in GDP per capita is discounted at 3%. Even if GDP per capita were constant in the presence of more rapid population growth, the benefit-cost ratio would be 60:1 if population growth could be reduced over the 50 year horizon at a cost of about 10% of GDP per capita.

percentage points). A parameter value of γ of close to 3, which has for instance been estimated for SSA by Bloom et al. (1998), would imply that the more rapid growth in the fraction of the population in the low fertility scenario results in a more rapid growth of GDP per capita of about .51%—a value that corresponds closely to the reduced population growth rate that is implied by the low fertility scenario as compared to the high fertility scenario. Very similar results also hold for other high fertility SSA countries (such as Nigeria).

There is considerable controversy about the validity of the country-level estimates of the demographic dividends, that is, the contribution of changing age structures to economic growth. Some of these concerns are of an econometric nature (Schultz 2010), while others question the applicability of the Asian experience—which is an important driver of the empirical results—to SSA. Notwithstanding these criticisms, however, if one takes the existing estimates of a demographic dividend (γ in the above notation) at their face value, they are consistent with our earlier discussions of Figures 15 and 16 and an approximate calculation that reductions in population growth translate one-to-one into increased rates of per capita GDP growth. If this is indeed the case, family planning programs are associated with significant benefit-cost ratios in terms of per capita income growth, possibly in the order of magnitude to 60:1 or higher. In interpreting this benefit-cost calculation, however, it is important to emphasize that the evidence underlying such benefit-cost calculations for the effect of family planning programs on increased growth of GDP per capita remains tenuous at best, and that there remains considerable uncertainty about the magnitude these effects that is very difficult to evaluate at this point.

7. SUMMARY AND CONCLUSIONS: A RANGE OF BENEFIT-COST RATIOS FOR POLICIES TARGETED AT REDUCING POPULATION GROWTH

Concerns about continued population growth in some of the least developed countries are well founded. Current high fertility countries (Figure 4) account currently for about 38% of the 78 million persons that are added annually to the world population, despite the fact that they are home to only 18% of the current world population. The current high fertility countries will make the largest contribution to the annual increment of the world population after 2018, and after 2060, world population is projected to grow exclusively as a result of population growth in the current high fertility countries (Figure 6). In the words of Lee (2009), “[it would seem] so obvious: Larger, more rapidly growing populations have fewer natural resources per person, less physical capital per worker, more dependents, and greater needs for new social infrastructure. Of course they must be economically worse off.” And if this is the case, family planning programs that facilitate a decline in fertility and a reduction in population growth rate would seem potentially highly beneficial interventions that should be expanded. And yet, this conclusion has been the subject of a long-standing and sometimes heated debate, often questioning the basic pillars of this conclusion (Kaiser 2011): For example, how detrimental, if at all, is population growth for economic development, individual well-being and the attainment of development indicators such as the Millennium Development Goals? Do family planning programs have causal effects towards reducing fertility, or would observed declines in family planning program areas also have been observed in the absence of these programs? Is there a window of opportunity in the next decades in which declines in population growth rates as a result of reduced fertility could provide a “demographic dividend” that would facilitate the social and economic development in some of the world’s most underdeveloped countries?

And while research in the last two decades has substantially strengthened the case for

family planning programs—documenting for example significant effects of these programs towards reducing fertility, increasing female (mother's) education, improving women's general health and longer-term survival, increases in female labor force participation and earnings, increased child health and increased child human capital (Section 3.4)—the attempt to obtain reasonably reliable estimates of the benefits, costs and benefit-cost ratios of these programs remains very challenging—or possibly almost impossible—given a plethora of estimation problems, a limited knowledge of program costs, and an even more difficult task of assessing the micro- and macro-level benefits of these programs (see Sections 3.3–3.4). And, of course, in the implementation of family planning programs many questions related to the optimal design of such programs are important (Mwaikambo et al. 2011; Population Council 2012; Prata 2009), including the appropriate integration of family planning programs with other health interventions, the adjustment to specific local contexts, the potential needs for health-systems strengthening, and the combination of family planning programs with information campaigns, behavioral change communication and interpersonal counseling. Negotiating population policies within specific political contexts is also non-trivial and can be challenging (Chimwete et al. 2005; May 2012; Robinson 2012). These specific aspects of program implementation and negotiation are beyond the scope of this paper. Nevertheless, in this section, we attempt to establish benefit-cost considerations based on the existing evidence, and then discuss the sensitivity of these results with respect to several sources of errors.

The costs of family planning programs in the past have varied widely (Section 6.1), and so do estimates of the costs of expanding family planning services in the current high fertility countries (Figure 4) that have the largest unmet need for such programs. Given the need to expand health systems and related infrastructures, the costs of expanding access to family planning per additional user are thought to exceed—at least in the short- to medium term—the average costs per current user in SSA contexts. Recent estimates, for example, suggest that additional annual expenditure of \$3.6 billions would allow expansion of family planning services to all women who currently have an unmet need. Arguably most useful for the present benefit-cost calculations are estimates of the family planning costs related to attaining the UN population forecasts (Moreland et al. 2010), which suggest that a reduction in the SSA population growth rate by 1 percentage point during 2005–50 would entail discounted family planning costs in the order of magnitude of about \$27 billion (or about 3% of current SSA GDP) (see Section 6). These estimates do not consider potentially necessary expansions of health systems that might be necessary to increase the family planning provisions to the required levels and possible costs of generating the demand for family planning (Population Council 2012), and so actual program costs may be significantly higher—however, based on the literature, it is difficult to make precise conclusions about the costs of these additional investments, which almost certainly, are context specific and highly variable across countries.

In terms of benefits, our discussion has focused on four categories. First, benefits that result from the fact that family planning programs may reduce expenditures on social programs as a result of a less rapidly growing size of birth cohorts, with savings including a reduced need for expanding the school system, providing education, implementing immunization programs or providing health care for children. However, these savings may potentially be misleading as in terms of reductions in social costs if family planning programs also result—as is suggested by much of the recent literature—in shifts in the demand for child quality (including for instance child health and schooling) and increases in female education (Section 3.2). Because the net effect is unclear, we do not consider these benefits in our benefit-cost calculations.

Second, benefits of family planning programs occur because reduced fertility, increased child spacing and possible reductions in unwanted fertility are likely to reduce both infant and maternal mortality. Some recent estimates of the reduction in child and maternal mortality that would result from expanding family planning programs to satisfy current unmet need suggest benefit-cost ratios in the order of magnitude of 30:1 to 50:1 resulting from the reduction in child and maternal mortality alone (Section 6.3). Some caution, however, is necessary in interpreting these numbers since it is not clear to what extent these estimates reflect the causal impact of expanding family planning programs on child/maternal mortality.

Third, our analyses have emphasized that family planning programs—in addition to reducing fertility and, related, maternal and child mortality—are likely to result in higher levels of female education, improvements in women's general health, increases in female labor force participation and earnings, increased child health (up and beyond the effect on reducing child mortality) and increased child human capital (see Section 3.4). Several of these factors will affect economic growth, and will therefore be considered as part of the benefits considered below. And while these consequences are likely to be desirable from a policy perspective up and beyond their contributions to economic growth, we will not consider these additional life-cycle, distributional and intergenerational benefits of family planning program due to the difficulties in evaluating them within the framework of this paper.

Fourth, and finally, benefits of large-scale family planning programs may result from changes in population dynamics, and in particular, from reductions in population growth rates, increases in the proportion of the population at working ages, and increases in levels of human capital and female labor force participation that result from reduced fertility over the next decades. It is important to emphasize that these aggregate effects of family planning programs—as of many other health interventions (Bleakley 2010)—are likely to be small in light of the vast differences in income levels among less developed countries, or between the least developed and more developed countries. Some recent discussions of the contribution of demographic change—and specifically declining fertility, age-structure changes and demographic dividends—to economic development in SSA seem rather optimistic in that regard (Sippel et al. 2011). Nevertheless, our review of the literature suggests in Sections 3.3 and 6.5 suggests that reductions in population growth rates by 1 percentage point in current high fertility countries may result in increases of the growth rate of per capita GDP by approximately 1 percentage point. This effect of reduced population growth on economic development is about twice as large as the effect that was suggested in the National Research Council (1986) report on *Population Growth and Economic Development* (see Section 3.3).²¹ Given the uncertainty in the underlying models, the still limited knowledge about population–development interactions, and the limitations of existing empirical estimates, all of which have been subject to a long and at times heated discussion, this finding is hardly more than a rule of thumb or back-of-the-envelope calculation. Nevertheless, if this estimate that reductions in population growth rates by 1 percentage point in current high fertility countries may result in increases of the growth rate of per capita GDP by approximately 1 percentage point is broadly accurate, it would suggest substantial benefit-

²¹The conclusions in National Research Council (1986) state: "A simple model suggests that the effect is comparatively modest. Using a typical labor coefficient of 0.5 in estimated production functions, a 1 percent reduction in the rate of labor force growth would boost the growth of per capita income by 0.5 percent per year." Since the report did not consider age structure effects, the growth rate of the labor force is equal to that of the population. The report's conclusions therefore continue: "Thus, after 30 years, a 1 percent reduction in the annual rate of population growth (produced, say, by a decline in the crude birth rate from 37 to 27 per 1,000) will have raised production and income per capita to a level 16 percent [= $\exp(.005 * 30) - 1$] above what it would otherwise have been."

Table 4: Summary of costs, benefits and benefit cost ratios for family planning programs

Annual Net Benefits and Costs (3 per cent discount rate)		Annual benefits	Annual costs of satisfying unmet need in developing countries	BCR
Benefit Component:	Assumptions	Billion USD	Billion USD	
Reduced Infant and Maternal Mortality	Low (DALY = 1K)	110	3.6	30
	High (DALY = 5K)	180		50
Income Growth (including life cycle, distributional and intergenerational benefits)	Low	216	3.6	60
	High	360		100
Total, Family Planning programs (sum)	Low	326	3.6	90
	High	470		150

cost ratios for family planning programs, possibly in the magnitude of 60:1 to 100:1 (or even higher) if the discounted costs of reducing population growth by 1 percentage in SSA are indeed in the order of magnitude of less than 10% of current SSA GDP during the next five decades (as is suggested by our discussion of the program costs above). The sizable benefit-cost ratios essentially result from the fact that reductions in fertility and population growth rates will result in sustained increases in GDP per capita over several decades in these calculations, and the costs of achieving these reductions in fertility and population growth are relatively modest when compared to current GDP levels in SSA and other least developed countries. However, one should not be mistaken about the magnitude of these aggregate economic effects in terms of closing substantial the income gap between the least developed countries and other developing or even developed countries. While these aggregate effects of family planning programs are likely to contribute substantially and favorably to the benefit-cost ratio of family planning programs, the aggregate effects are too small for these programs to significantly reduce global income inequalities or to provide a substitute for other development policies. More likely, a convincing case can be made for integrating family planning programs with other development policies (APPG 2007; Canning 2012; Cleland et al. 2006; Eastwood and Lipton 2011; Global Agenda Council on Population Growth 2012; Sippel et al. 2011; Teller and Hailemariam 2011; Wilcher et al. 2009), including those that target reproductive-health concerns such as HIV/AIDS or other infectious diseases (including specifically also those reducing infant/child mortality) and/or development policies that would help create the institutional environment to capture the demographic dividend from reduced population growth and changes in the population age structure that are likely to occur in the next decades.

Combining the above estimates of the benefit-cost ratios for family planning programs in the area of reducing maternal/child mortality and increasing income per capita suggest benefit-cost ratios for investments in family planning programs of 90:1 to 150:1. Table 4 summarizes how these benefit-cost ratios arise from benefits in terms of reduced infant and maternal mortality and income growth. High and low estimates for the former are due to different evaluations of life, and in the latter, due to different costs of achieving a specific reduction in fertility and population growth rates. The table also reports the estimated costs of satisfying the total current unmet need for family planning in developing countries, obtained from Singh et al. (2010) (see also Section 6.1), as well as the total benefits resulting from this investment in family planning based on the benefit-cost ratios obtained reported in this table.

Several caveats need to be emphasized when interpreting these favorable benefit-cost

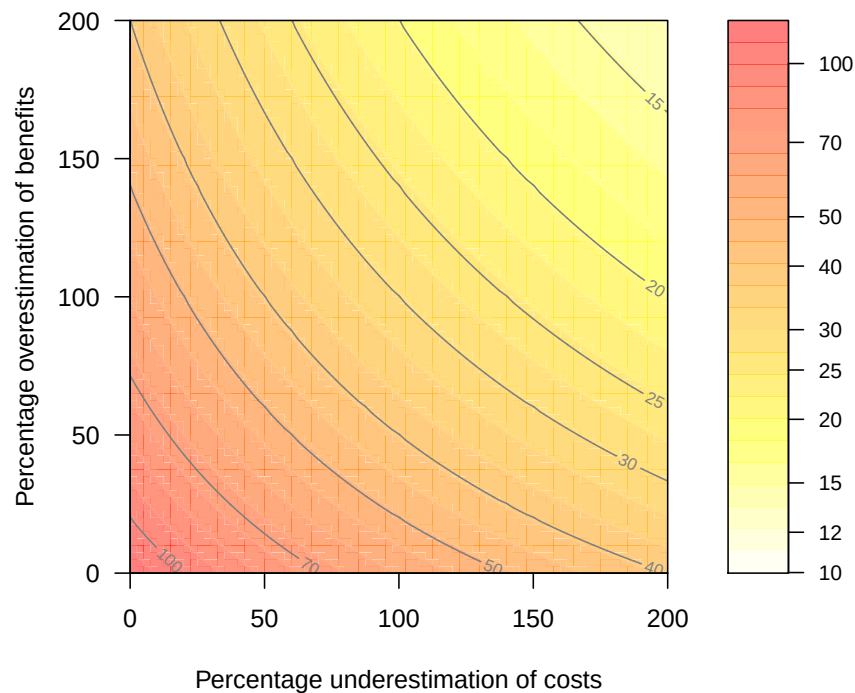


Figure 17: Robustness of benefit-cost calculations: benefit-Cost Ratio for family planning programs if costs are underestimated and/or benefits are overestimated by a factor of up to 200%

ratios for family planning programs. On the one hand, since there is evidence that family planning programs result in benefits that are not considered here, such as climate change, environmental sustainability and political stability (Goldstone et al. 2012; O'Neill et al. 2010; Speidel et al. 2009; Sulston et al. 2012), one could argue that the actual benefit-cost ratios are likely to be higher. On the other hand, we have emphasized throughout this paper that, despite the progress in the literature during the last two decades, the empirical basis for conducting these benefit-cost calculations remains somewhat weak, and significant uncertainty prevails in both the assessments of the costs of these programs and their expansion, as well as in terms of the causal effects in terms a range of benefits that these programs will produce. It is easy to argue that many biases in the existing literature will tend to over-state the benefits resulting from family planning programs and under-state the costs of these programs and their expansion (Sections 6.1–6.5). Thus, the above benefit-cost ratios would tend to be over-estimates. Based on the current literature, it is impossible to establish with confidence how large these biases might be. However, the magnitude of the benefit-cost ratios for family planning programs that emerge from our analyses, and the relatively convincing recent empirical micro- and macro-evidence about the benefits resulting from family planning programs and reductions in fertility, a fairly favorable assessment of family planning programs in terms of their benefit-cost ratios and cost-effectiveness seems to be justified and relatively robust with respect to measurement errors. For example, Figure 17 illustrates how a benefit-cost ratio of 120, which is the average of the high and low overall benefit-cost ratios reported in Table 4, would change if the costs of family planning programs were underestimated, and/or the benefits of these programs were overestimated, by a factor of up to 200% (i.e., if the costs were up to 3-times as high, and/or the benefits were only 1/3 as high as is assumed in the current calculation

of the benefit-cost ratios in Table 4). Even in the most pessimistic assumption in Figure 17 when the costs are 3-times as high *and* the benefits are only 1/3 as high as is currently assumed in Table 4, the benefit-cost ratio are fairly favorable and in excess of 13:1; and, of course, the benefit-cost ratios are higher if the underestimation of the costs and/or the overestimation of the benefits is less pronounced.

In summary, therefore, the conclusion based on this review of the literature and assessment of benefit-cost ratios for the expansion of family planning programs is quite consistent with several related recent studies that have argued in favor of the expansion of family planning programs (Ashraf et al. 2008; Babigumira et al. 2012; Chao 2005; Cleland et al. 2006, 2012; Haveman 1976; Hubera and Harveya 1989; Joshi and Schultz 2007; Levine et al. 2006; Miller 2010; Simmons et al. 1991; USAID Health Policy Initiative 2009b; Wulf 1981). Our discussion and benefit-cost analyses thus lend support to earlier analyses that have argued that family planning programs are a good “*economic investment*” (Bongaarts and Sinding 2011b) and the renewed emphasis on family planning programs in light of continued population growth in some of the world’s least developed countries (Section 2) is very much supported by the present analyses. In expanding family planning programs, it is clear—and supported by a fairly broad consensus—that these programs must be voluntary and based on a long-term commitment of resources, and empirical studies suggest that, in order to be effective, family planning programs are ideally integrated with other reproductive and child health services, effective community-based programs and potentially related behavioral change communication. There is also a rich body of empirical evidence and experience that can inform the important open questions about the optimal design and implementation of these programs (Section 3.4). And while the *Expert Panel* of the Copenhagen Consensus Project 2012 Copenhagen Consensus Project (2012) did not rank family planning programs particularly favorable in comparison with other proposed interventions for confronting ten great contemporary global challenges, the readers of the *Slate Magazine Forum* accompanying the Copenhagen Consensus 2012 Project ranked population growth and family planning as a top priority (Lomborg 2012a,b). Based on the evidence reviewed in this paper, this author tends to agree with the *Slate* readers. Indeed, as recently stated by Melinda Gates (2012b), “*Let’s put birth control back on the agenda*”.

REFERENCES

- Abbasi-Shavazi, M. J., McDonald, P. and Hossein-Chavoshi, M. (2009a). *The fertility transition in Iran: Revolution and reproduction*. Berlin: Springer.
- Abbasi-Shavazi, M. J., Morgan, S. P., Hossein-Chavoshi, M. and McDonald, P. (2009b). Family change and continuity in Iran: Birth control use before first pregnancy. *Journal of Marriage and Family* 71(5): 1309–1324. doi:10.1111/j.1741-3737.2009.00670.x.
- Acemoglu, D. and Johnson, S. (2007). Disease and development: The effect of life expectancy on economic growth. *Journal of Political Economy* 115(6): 925–985.
- Acemoglu, D. and Robinson, J. (2012). *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. New York, NY: Crown Business.
- Ahmed, S., Li, Q. F., Liu, L. and Tsui, A. (2012). Maternal deaths averted by contraceptive use: An analysis of 172 countries. *Lancet* forthcoming. Preliminary version is available at <http://paa2012.princeton.edu/download.aspx?submissionId=122679>.
- Akerlof, G. A. (1997). Social distance and social decisions. *Econometrica* 65(5): 1005–1027.
- Aldy, J. E. and Viscusi, W. K. (2007). Age differences in the value of statistical life: Revealed preference evidence. *Review of Environmental Economics and Policy* 1: 241–260. doi:10.1093/reep/rem014.
- Alesina, A., Giuliano, P. and Nunn, N. (2011a). Fertility and the plough. *American Economic Review* 101(3): 499–503. doi:10.1257/aer.101.3.499.
- Alesina, A. F., Giuliano, P. and Nunn, N. (2011b). On the origins of gender roles: Women and the plough. NBER Working Paper No. 17098, <http://www.nber.org/papers/w17098>.
- APPG (2007). Return of the population growth factor: Its impact on the Millennium Development Goals. All Party Parliamentary Group on Population Development and Reproductive Health (APPG), UK Parliament, London, www.appg-popdevrh.org.uk.
- Arends-Kuenning, M. (2001). How do family planning worker visits affect women's behavior in Bangladesh? *Demography* 38(4): 481–496.
- Arndt, C., Jones, S. and Tarp, F. (2009). Aid and growth: Have we come full circle? University of Copenhagen Dept. of Economics Discussion Paper No. 09-22, <http://ssrn.com/abstract=1489392>.
- Arthur, W. B. and McNicoll, G. (1978). An analytical survey of population and development in Bangladesh. *Population and Development Review* 4(1): 23–80.
- Ashraf, N., Field, E. and Lee, J. (2010). Household bargaining and excess fertility: A study in zambia. Harvard Business School: Unpublished Manuscript, http://people.hbs.edu/nashraf/papers/Ashraf_Field_Lee_December2010.pdf.
- Ashraf, Q. H., Lester, A. and Weil, D. N. (2008). When does improving health raise GDP? NBER Working Paper #14449.
- Ashraf, Q. H., Weil, D. N. and Wilde, J. (2011). The effect of interventions to reduce fertility on economic growth. NBER Working Paper #17377, <http://www.nber.org/papers/w17377>.
- Babigumira, J. B., Stergachis, A., Veenstra, D. L., Gardner, J. S., Ngonzi, J., Mukasa-Kivunike, P. and Garrison, L. P. (2012). Potential cost-effectiveness of universal access to modern contraceptives in Uganda. *PLoS ONE* 7(2): e30735–. doi:10.1371/journal.pone.0030735.
- Bailey, M. J. (2006). More power to the pill: The impact of contraceptive freedom on women's life cycle labor supply. *Quarterly Journal of Economics* 121(1): 289–320.
- Ballard, C., Shoven, J. and Whalley, J. (1985). General equilibrium computations of the marginal welfare costs of taxes in the United States. *American Economic Review* 75(1):

- 128–138.
- Barham, T. (2012). Enhancing cognitive functioning: Medium-term effects of a health and family planning program in Matlab. *American Economic Journal: Applied Economics* 4(1): 245–73. doi:10.1257/app.4.1.245.
- Bartick, M. and Reinhold, A. (2010). The burden of suboptimal breastfeeding in the United States: A pediatric cost analysis. *Pediatrics* 125(5): 1048–1058.
- Becker, G. S. (1974). A theory of social interaction. *Journal of Political Economy* 82(6): 1063–1093.
- Becker, G. S. (1991). *A Treatise on the Family*. Cambridge, MA: Harvard University Press, second edn.
- Becker, G. S. and Barro, R. J. (1988). A reformulation of the economic theory of fertility. *Quarterly Journal of Economics* 103(1): 1–25.
- Becker, G. S., Murphy, K. M. and Tamura, R. (1990). Human capital, fertility, and economic growth. *Journal of Political Economy* 98(5, pt. 2): 12–37.
- Behrman, J. R., Alderman, H. and Hoddinott, J. (2004). Hunger and malnutrition. In: Lomborg, B. (ed.). *Global Crises, Global Solutions*. Cambridge: Cambridge University Press, 363–420. (see also <http://www.copenhagenconsensus.com>), (seealso<http://www.copenhagenconsensus.com>).
- Behrman, J. R. and Knowles, J. C. (1998). Population and reproductive health: An economic framework for policy evaluation. *Population and Development Review* 24(4): 697–737.
- Behrman, J. R. and Kohler, H.-P. (2011). Sexual transmission of HIV. Assessment paper for the Copenhagen Consensus Project 2011 on HIV/AIDS in sub-Saharan Africa, <http://www.rethinkHIV.com>.
- Belfield, C. and Levin, H. (2010). Cost-benefit analysis and cost-effectiveness analysis. In: Peterson, P., Baker, E. and McGaw, B. (eds.). *International Encyclopedia of Education (Third Edition)*. Oxford: Elsevier, 199–203. doi:10.1016/B978-0-08-044894-7.01245-8.
- Bergstrom, T. C. (1997). A survey of theories of the family. In: Rosenzweig, M. A. and Stark, O. (eds.). *Handbook of Population and Family Economics*. Amsterdam: North Holland.
- Bernardi, L., Klärner, A. and von der Lippe, H. (2008). Job insecurity and the timing of parenthood: A comparison between eastern and western Germany. *European Journal of Population* 24(3): 287–313.
- Bernstein, S. (2006). Public choices, private decisions: Sexual and reproductive health and the Millennium Development Goals. UN Millennium Project, http://www.unmillenniumproject.org/documents/MP_Sexual_Health_screen-final.pdf.
- Birdsall, N., Kelley, A. C. and Sinding, S. (eds.) (2001). *Population Matters – Demographic Change, Economic Growth, and Poverty in the Developing World*. Oxford: Oxford University Press.
- Black, S. E., Devereux, P. J. and Salvanes, K. G. (2005). The more the merrier? The effect of family composition on children's education. *Quarterly Journal of Economics* 120(2): 669–700. doi:10.1162/0033553053970179.
- Bleakley, H. (2008). When does improving health raise GDP? comments on Ashraf, Lester, and Weil (2008). University of Chicago, unpublished manuscript, http://home.uchicago.edu/~bleakley/Bleakley_Comments_ALW.pdf.
- Bleakley, H. (2010). Health, human capital, and development. *Annual Review of Economics* 2(1): 283–310. doi:10.1146/annurev.economics.102308.124436.
- Bleakley, H. and Lange, F. (2009). Chronic disease burden and the interaction of education, fertility, and growth. *Review of Economics and Statistics* 91(1): 52–65. doi:10.1162/rest.91.1.52.

- Bloom, D., Canning, D., Fink, G. and Finlay, J. E. (2009a). Fertility, female labor force participation, and the demographic dividend. *Journal of Economic Growth* 14(2): 79–101. doi:10.1007/s10887-009-9039-9.
- Bloom, D. E. and Canning, D. (2004). Global demographic change: Dimensions and economic significance. NBER Working Paper No. 10817, <http://www.nber.org/papers/w10817>.
- Bloom, D. E. and Canning, D. (2008). Global demographic change: Dimensions and economic significance. *Population and Development Review* 34(Supplement): 17–51.
- Bloom, D. E., Canning, D. and Fink, G. (2009b). Disease and development revisited. NBER Working Paper #15137, <http://www.nber.org/papers/w15137>.
- Bloom, D. E., Canning, D., Fink, G. and Finlay, J. (2007a). Does age structure forecast economic growth? NBER Working Paper No. 13221, <http://www.nber.org/papers/w13221>.
- Bloom, D. E., Canning, D., Fink, G. and Finlay, J. (2007b). Realizing the demographic dividend: Is Africa any different? Program on the Global Demography of Aging, Harvard University, PGDA Working Paper No. 23, <http://www.hsph.harvard.edu/pgda/working.htm>.
- Bloom, D. E., Canning, D. and Sevilla, J. (2002). *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*. Santa Monica, CA: RAND Corporation.
- Bloom, D. E., Sachs, J. D., Collier, P. and Udry, C. (1998). Geography, demography, and economic growth in Africa. *Brookings Papers on Economic Activity* 1998(2): 207–295.
- Bongaarts, J. (1987). Does family planning reduce infant mortality rates? *Population and Development Review* 13(2): 323–334.
- Bongaarts, J. (1994). The impact of population policies: Comment. *Population and Development Review* 20(3): 616–620.
- Bongaarts, J. (2006). The causes of stalling fertility transitions. *Studies in Family Planning* 37(1): 1–16.
- Bongaarts, J. (2008). Fertility transitions in developing countries: Progress or stagnation? *Studies in Family Planning* 39(2): 105–110. doi:10.1111/j.1728-4465.2008.00157.x.
- Bongaarts, J. (2011). Can family planning programs reduce high desired family size in Sub-Saharan Africa? *International Perspectives on Sexual and Reproductive Health* 37(4).
- Bongaarts, J. and Bruce, J. (1995). The causes of unmet need for contraception and the social content of services. *Studies in Family Planning* 26(2): 57–75.
- Bongaarts, J., Mauldin, W. P. and Phillips, J. (1990). The demographic impact of family planning programs. *Studies in Family Planning* 21(6): 299–310.
- Bongaarts, J. and Sinding, S. (2011a). Population policy in transition in the developing world. *Science* 333(6042): 574–576. doi:10.1126/science.1207558.
- Bongaarts, J. and Sinding, S. W. (2009). A response to critics of family planning programs. *International Perspectives on Sexual and Reproductive Health* 35(3): 153–154.
- Bongaarts, J. and Sinding, S. W. (2011b). Family planning as an economic investment. *SAIS Review* 31(2): 35–44.
- Bongaarts, J. and Watkins, S. C. (1996). Social interactions and contemporary fertility transitions. *Population and Development Review* 22(4): 639–682.
- Bongaarts, J. P., Pelletier, c., Fran and Gerland, P. (2011). Global trends in AIDS mortality. In: Rogers, R. G. and Crimmins, E. M. (eds.). *International Handbooks of Population*. New York: Springer, vol. 2, 171–183. doi:10.1007/978-90-481-9996-9_8.
- Boserup, E. (1965). *The Conditions of Agricultural Growth*. New York: Aldine Publishing.

- Boserup, E. (1981). *Population and Technological Change: A Study of Long Term Trends*. Chicago: University of Chicago Press.
- Caldwell, J. C. (1980). Mass education as a determinant of the timing of fertility decline. *Population and Development Review* 6(2): 225–255.
- Caldwell, J. C. and Caldwell, P. (1987). The cultural context of high fertility in sub-Saharan africa. *Population and Development Review* 13(3): 409–437.
- Caldwell, J. C., Caldwell, P. and Orubuloye, I. O. (1992). The family and sexual networking in sub-Saharan Africa—Historical regional differences and present-day implications. *Population Studies* 46(3): 385–410.
- Campbell, M. (2007). Why the silence on population? *Population & Environment* 28(4): 237–246. doi:10.1007/s11111-007-0054-5.
- Campbell, M. and Bedford, K. (2009). The theoretical and political framing of the population factor in development. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1532): 3093–3099. doi:10.1098/rstb.2009.0172.
- Campbell, M., Cleland, J., Ezeh, A. and Prata, N. (2007). Return of the population growth factor. *Science* 315(5818): 1501–1502. doi:10.1126/science.1140057.
- Canning, D. (2011). The causes and consequences of demographic transition. *Population Studies* 65(3): 353–361. doi:10.1080/00324728.2011.611372.
- Canning, D. (2012). Copenhagen consensus perspective paper on “Infectious Disease”. Copenhagen Consensus Project 2012, <http://www.copenhagenconsensus.com>.
- Casterline, J. B. and Sinding, S. W. (2000). Unmet need for family planning in developing countries and implications for population policy. *Population and Development Review* 26(4): 691–723. doi:10.1111/j.1728-4457.2000.00691.x.
- Cates, W., Karim, Q. A., El-Sadr, W., Haffner, D. W., Kalema-Zikusoka, G., Rogo, K., Petruney, T. and Averill, E. M. D. (2010). Family planning and the Millennium Development Goals. *Science* 329(1603): 1603. doi:10.1126/science.1197080.
- Chao, D. N. (2005). Family planning in Egypt is a sound financial investment. US-AID Health Policy Initiative, <http://www.healthpolicyinitiative.com/index.cfm?ID=publications&get=pubID&pubID=43>.
- Chao, D. N. W. and Allen, K. B. (1984). A cost-benefit analysis of Thailand’s family planning program. *International Family Planning Perspectives* 10(3): 75–81.
- Chimbwete, C., Zulu, E. M. and Watkins, S. C. (2005). The evolution of population policies in Kenya and Malawi. *Population Research and Policy Review* 24(1): 83–104.
- Cincotta, R., Engelman, R. and Anastasion, D. (2003). *The Security Demographic: Population and Civil Conflict After the Cold War*. Washington, DC: Population Action International.
- Cleland, J., Bernstein, S., Ezeh, A., Faundes, A., Glasier, A. and Innis, J. (2006). Family planning: The unfinished agenda. *Lancet* 368(9549): 1810–1827. doi:10.1016/S0140-6736(06)69480-4.
- Cleland, J., Conde-Agudelo, A., Peterson, H., Ross, J. and Tsui, A. (2012). Contraception and health. *Lancet* forthcoming.
- Cleland, J. and Wilson, C. (1987). Demand theories of the fertility transition: An iconoclastic view. *Population Studies* 41(1): 5–30.
- Cleland, J. G., Ndugwa, R. P. and Zulu, E. M. (2011). Family planning in sub-Saharan Africa: progress or stagnation? *Bulletin of the World Health Organization* 89: 137–143. doi:10.1590/S0042-96862011000200013.
- Coale, A. J. (1973). The demographic transition reconsidered. In: *International Population Conference, Liège, 1973, Vol. 1*. International Union for the Scientific Study of Population, 53–72.

- Coale, A. J. and Hoover, E. M. (1958). *Population Growth and Economic Development in Low-Income Countries*. Princeton: Princeton University Press.
- Cohen, J. E. (1995a). *How many people can the earth support?* New York, NY: Norton & Co.
- Cohen, J. E. (1995b). Population growth and earth's human carrying capacity. *Science* 269(5222): 341–346. doi:10.1126/science.7618100.
- Collumbien, M., Gerressu, M. and Cleland, J. (2004). Non-use and use of ineffective methods of contraception. In: Ezzati, M., Lopez, A. D., A., R. and Murray, C. J. L. (eds.). *Comparative quantification of health risks, global and regional burden of disease attributable to selected major risk factors*. Geneva: World Health Organization, 1255–1320.
- Connelly, M. (2008). *Fatal Misconception: The Struggle to Control World Population*. Cambridge, MA, and London: Belknap Press of Harvard University Press.
- Copenhagen Consensus Project (2012). Expert Panel Findings. Copenhagen Consensus Project 2012, Final Outcome Document, <http://www.copenhagenconsensus.com/Default.aspx?ID=1637>.
- Crouter, A. C. and Booth, A. (eds.) (2005). *The New Population Problem: Why Families in Developed Countries are Shrinking and What it Means*. Mahwah, N.J.: Lawrence Erlbaum Associates.
- Cutler, D. M., Deaton, A. S. and Lleras-Muney, A. (2006). The determinants of mortality. *Journal of Economic Literature* 20(3): 97–120.
- Darroch, J. and Singh, S. (2011). Adding it up: The costs and benefits of investing in family planning and maternal and newborn health (estimation methodology). Guttmacher Institute Report, <http://www.guttmacher.org/pubs/AIU-methodology.pdf>.
- Das Gupta, M., Bongaarts, J. and Cleland, J. C. (2011). Population, poverty, and sustainable development: A review of the evidence. Policy Research Working Paper (5719), <http://elibrary.worldbank.org/content/workingpaper/10.1596/1813-9450-5719>.
- Dasgupta, P. (1993). *An Inquiry into Well-Being and Destitution*. Oxford: Clarendon Press.
- Dasgupta, P. (1995). The population problem: Theory and evidence. *Journal of Economic Literature* 33(4): 1879–1902.
- David, H. P. (2006). Born unwanted, 35 years later: The prague study. *Reproductive Health Matters* 14(27): 181–190. doi:10.1016/S0968-8080(06)27219-7.
- Deaton, A. (2010). Instruments, randomization, and learning about development. *Journal of Economic Literature* 48(2): 424–455. doi:10.1257/jel.48.2.424.
- Debpuur, C., Phillips, J. F., Jackson, E. F., Nazzar, A., Ngom, P. and Binka, F. N. (2002). The impact of the Navrongo Project on contraceptive knowledge and use, reproductive preferences, and fertility. *Studies in Family Planning* 33(2): 141–164. doi:10.1111/j.1728-4465.2002.00141.x.
- Demeny, P. (1986). Population and the invisible hand. *Demography* 23(4): 473–487.
- Demeny, P. (2011). Population policy and the demographic transition: Performance, prospects, and options. *Population and Development Review* 37(Supplement): 249–274. doi:10.1111/j.1728-4457.2011.00386.x.
- Devarajan, S., Squire, L. and Suthiwart-Narueput, S. (1997). Beyond rate of return: Reorienting project appraisal. *World Bank Research Observer* 12(1): 35–46.
- Dewey, K. G. and Cohen, R. J. (2007). Does birth spacing affect maternal or child nutritional status? A systematic literature review. *Maternal & Child Nutrition* 3(3): 151–173.
- Dixon-Mueller, R. (1993). *Population Policy and Women's Rights: Transforming Reproductive Choice*. Westport, CT: Praeger Press.
- Do, Q.-T. and Phung, T. D. (2010). The importance of being wanted. *American Economic Journal: Applied Economics* 2(4): 236–53. doi:10.1257/app.2.4.236.

- Duflo, E., Glennerster, R. and Kremer, M. (2007). Using randomization in development economics research: A toolkit. In: Schultz, T. P. and Strauss, J. A. (eds.). *Handbook of Development Economics*. New York: Elsevier, 3895–3962. CEPR Discussion Paper No. 6059 Available at SSRN: <http://ssrn.com/abstract=997109>.
- Dyson, T. (2010). *Population and Development: The Demographic Transition*. London: Zed Books.
- Dytrych, Z., Matejcek, Z., Schuller, V., David, H. and Friedman, H. (1975). Children born to women denied abortion. *Family Planning Perspectives* 7(4): 165–171.
- Easterlin, R. A. and Crimmins, E. (1985). *The Fertility Revolution*. Chicago: University of Chicago Press.
- Eastwood, R. and Lipton, M. (2011). Demographic transition in sub-Saharan Africa: How big will the economic dividend be? *Population Studies* 65(1): 9–35. doi:10.1080/00324728.2010.547946.
- Eberstadt, N. (2006). Doom and demography. *Wilson Quarterly* 30(1): 27–31.
- Ehrlich, P. R. (1968). *The Population Bomb*. New York, NY: Ballantine.
- Ehrlich, P. R. and Ehrlich, A. H. (1990). *The Population Explosion*. New York, NY: Simon & Schuster.
- England, P. and Folbre, N. (2002). Involving dads: Parental bargaining and family well-being. In: Tamis-LeMonda, C. S. and Cabrera, N. (eds.). *Handbook of Father Involvement: Multidisciplinary Perspectives*. Mahwah, NJ: Erlbaum Associates, 387–408.
- Espenshade, T. J., Guzman, J. C. and Westoff, C. F. (2003). The surprising global variation in replacement fertility. *Population Research and Policy Review* 22(5-6): 575–583.
- Ezeh, A. C., Mberu, B. U. and Emina, J. O. (2009). Stall in fertility decline in Eastern African countries: regional analysis of patterns, determinants and implications. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1532): 2985–2990. doi:10.1098/rstb.2009.0137.
- FAO (2011). FAOSTAT online database. Food and Agricultural Organization (FAO), <http://faostat.fao.org>.
- Feldstein, M. (1995). Tax avoidance and the deadweight loss of the income tax. NBER Working Paper No. 5055, <http://www.nber.org>.
- Fernández, R., Fogli, A. and Olivetti, C. (2004). Mothers and sons: Preference formation and female labor force dynamics. *Quarterly Journal of Economics* 119(4): 1249–1299.
- Fortson, J. G. (2009). HIV/AIDS and fertility. *American Economic Journal: Applied Economics* 1(3): 170–194.
- Frankenberg, E., Sikoki, B. and Suriastini, W. (2003). Contraceptive use in a changing service environment: Evidence from Indonesia during the economic crisis. *Studies in Family Planning* 34(2): 103–116. doi:10.1111/j.1728-4465.2003.00103.x.
- Freedman, R. (1997). Do family planning programs affect fertility preferences? A literature review. *Studies in Family Planning* 28(1): 1–13.
- Freedman, R. and Takeshita, J. Y. (1969). *Family Planning in Taiwan: An Experiment in Social Change*. Princeton: Princeton University Press.
- Galor, O. (2005). From stagnation to growth: Unified growth theory. In: Aghion, P. and Durlauf, S. N. (eds.). *Handbook of Economic Growth*. Elsevier, vol. Volume 1, Part A, 171–293. doi:10.1016/S1574-0684(05)01004-X.
- Galor, O. (2011). *Unified Growth Theory*. Princeton, NJ: Princeton University Press.
- Galor, O. (2012). The demographic transition: Causes and consequences. IZA Discussion Paper No. 6334, <http://ssrn.com/abstract=2003667>.
- Galor, O. and Tsiddon, D. (1991). Technological breakthroughs and development traps.

- Economics Letters* 37(1): 11–17. doi:10.1016/0165-1765(91)90235-D.
- Galor, O. and Weil, D. N. (1996). The gender gap, fertility and growth. *American Economic Review* 86(3): 374–387.
- Garenne, M. L. (2011). Testing for fertility stalls in demographic and health surveys. *Population Health Metrics* 1(7): 18.
- Gates, B. (2012a). 2012 *Annual Letter From Bill Gates*. Bill & Melinda Gates Foundation. <http://www.gatesfoundation.org/annual-letter/2012>.
- Gates, M. (2012b). Let's put birth control back on the agenda. Presentation at the TED Summit, April 2012, http://www.ted.com/talks/melinda_gates_let_s_put_birth_control_back_on_the_agenda.html.
- Gertler, P. J. and Molyneaux, J. W. (1994). How economic development and family planning programs combined to reduce Indonesian fertility. *Demography* 31(1): 33–63.
- Glaeser, E. L. (2011). *Triumph of the city: How our greatest invention makes us richer, smarter, greener, healthier, and happier*. New York, NY: Penguin Press.
- Global Agenda Council on Population Growth (2012). Seven billion and growing: A 21st century perspective on population. World Economic Forum.
- Goldin, C. and Katz, L. F. (2002). The power of the pill: Oral contraceptives and women's career and marriage decisions. *Journal of Political Economy* 110(4): 730–770.
- Goldstone, J. A., Kaufmann, E. P. and Toft, M. D. (eds.) (2012). *Political Demography: How Population Changes Are Reshaping International Security and National Politics*. Paradigm Publisher.
- Golosov, M., Jones, L. E. and Tertilt, M. (2007). Efficiency with endogenous population growth. *Econometrica* 75(4): 1039–1071. doi:10.1468-0262.2007.00781.x.
- Government of Kenya (2010). *Kenya: Population and Development (RAPID Booklet)*. Washington, DC: USAID Health Policy Initiative. http://www.healthpolicyinitiative.com/Publications/Documents/1095_1_Kenya_booklet_3_31_10_sgilepg_LOW_RES_PDF_for_INTERNET_acc.pdf.
- Government of Malawi (2010). *Malawi: Population and Development (RAPID Booklet)*. Washington, DC: USAID Health Policy Initiative. http://www.healthpolicyinitiative.com/Publications/Documents/1065_1_Malawi_booklet_2_23_10_singlepg_acc.pdf.
- Granovetter, M. S. (1978). Threshold models of collective behavior. *American Journal of Sociology* 83(6): 1420–1443.
- Greenwood, J., Seshadri, A. and Vandenbroucke, G. (2005). The baby boom and baby bust. *American Economic Review* 95(1): 183–207.
- Guinnane, T. W. (2011). The historical fertility transition: A guide for economists. *Journal of Economic Literature* 49(3): 589–614. doi:10.1257/jel.49.3.589.
- Haddad, L. and Hoddinott, J. (1994). Does female income share influence household expenditures? Evidence from Côte-d'Ivoire. *Oxford Bulletin of Economics and Statistics* 57(1): 77–96.
- Hammitt, J. K. (2007). Valuing changes in mortality risk: Lives saved versus life years saved. *Review of Environmental Economics and Policy* 1: 228–240. doi:10.1093/reep/rem015.
- Hanushek, E. A. (1992). The trade-off between child quantity and quality. *Journal of Political Economy* 100(1): 84–117.
- Harberger, A. (1997). New frontiers in project evaluation? A comment on Devarajan, Squire and Suthiwart-Narueput. *World Bank Research Observer* 12(1): 73–79.
- Hardin, G. (1968). The tragedy of the commons. *Science* 162: 1243–1248.
- Haveman, R. H. (1976). Benefit-cost analysis and family planning programs. *Population and*

- Development Review* 2(1): 37–64.
- Heaton, T. (2011). Does religion influence fertility in developing countries. *Population Research and Policy Review* 30(3): 449–465. doi:10.1007/s11113-010-9196-8.
- Herbst, A. J., Cooke, G. S., Bärnighausen, T., KanyKany, A., Tanser, F. and Newell, M.-L. (2009). Adult mortality and antiretroviral treatment roll-out in rural KwaZulu-Natal, South Africa. *Bulletin of the World Health Organization* 87(10): 754–762. doi:10.1590/S0042-96862009001000011.
- Hewlett Foundation (2012). Global development and population program. The William and Flora Hewlett Foundation, <http://www.hewlett.org/programs/global-development-and-population-program>.
- Hobcraft, J. N., McDonald, J. W. and Rutstein, S. O. (1984). Socio-economic factors in infant and child mortality: A cross-national comparison. *Population Studies* 38(2): 193–223.
- Hoddinott, J., Rosegrant, M. and Torero, M. (2012). Copenhagen consensus challenge paper on “Hunger and Malnutrition”. Copenhagen Consensus Project 2012, <http://www.copenhagenconsensus.com>.
- Horton, S., Alderman, H. and Rivera, J. A. (2009). The challenge of hunger and malnutrition. In: Lomborg, B. (ed.). *Global Crises, Global Solutions: Second Edition*. Cambridge, MA: Cambridge University Press.
- Hubera, S. C. and Harveya, P. D. (1989). Family planning programmes in ten developing countries: cost effectiveness by mode of service delivery. *Journal of Biosocial Science* 21: 267–277. doi:10.1017/S0021932000017971.
- Jacobs, J. (1969). *The Economy of Cities*. New York: Random House.
- Jahn, A., Floyd, S., Crampin, A. C., Mwaungulu, F., Mvula, H., Munthali, F., McGrath, N., Mwafilaso, J., Mwinuka, V., Mangongo, B., Fine, P. E. M., Zaba, B. and Glynn, J. R. (2008). Population-level effect of HIV on adult mortality and early evidence of reversal after introduction of antiretroviral therapy in Malawi. *Lancet* 371(9624): 1603–1611. doi:10.1016/S0140-6736(08)60693-5.
- Jamison, D., Jha, P., Laxminarayan, R. and Ord, T. (2012). Copenhagen consensus challenge paper on “Infectious Disease”. Copenhagen Consensus Project 2012, <http://www.copenhagenconsensus.com>.
- Jamison, D. T., Jha, P. and Bloom, D. (2009). The challenge of diseases. In: Lomborg, B. (ed.). *Global Crises, Global Solutions: Second Edition*. Cambridge, MA: Cambridge University Press.
- Jensen, R. and Oster, E. (2009). The power of TV: Cable television and women’s status in India. *Quarterly Journal of Economics*.
- Jha, P., Nugent, R., Verguet, S. and Bloom, D. (2012). Copenhagen consensus challenge paper on “Chronic Disease”. Copenhagen Consensus Project 2012, <http://www.copenhagenconsensus.com>.
- Johnson-Hanks, J. (2006). *Uncertain Honor: Modern Motherhood in an African Crisis*. Chicago, I.L.: University of Chicago Press.
- Joshi, S. (2011). How effective are family-planning programs at improving the lives of women? Some perspectives from a vast literature. World Bank, Unpublished manuscript, http://siteresources.worldbank.org/INTGENDER/Resources/FPPPrograms_Impact_Review.pdf.
- Joshi, S. and Schultz, T. P. (2007). Family planning as an investment in development: Evaluation of a program’s consequences in Matlab, Bangladesh. Yale University Economic Growth Center Discussion Paper No. 951, <http://ssrn.com/abstract=962938>.
- Kaiser, J. (2011). Does family planning bring down fertility? *Science* 333(6042): 548–549.

- doi:10.1126/science.333.6042.548.
- Kalemli-Ozcan, S. (2003). A stochastic model of mortality, fertility, and human capital investment. *Journal of Development Economics* 70(1): 103–118. doi:10.1016/S0304-3878(02)00089-5.
- Kalemli-Ozcan, S. and Turan, B. (2011). HIV and fertility revisited. *Journal of Development Economics* 96(1): 61–65. doi:10.1016/j.jdeveco.2010.08.001.
- Kelley, A. C. (1988). Economic consequences of population change in the Third World. *Journal of Economic Literature* 26: 1685–1728.
- Kelley, A. C. and Schmidt, R. M. (2005). Evolution of recent economic-demographic modeling: A synthesis. *Journal of Population Economics* 18(2): 275–300. doi:10.1007/s00148-005-0222-9.
- Kelley, R. M., Allen C. and Schmidt (1995). Aggregate population and economic growth correlations: The role of the components of demographic change. *Demography* 32(4): 543–555. doi:10.2307/2061674.
- Knowles, J. C., Akin, J. S. and Guilkey, D. K. (1994). The impact of population policies: Comment. *Population and Development Review* 20(3): 611–615.
- Knowles, J. C. and Behrman, J. R. (2003). Assessing the economic returns to investing in youth in developing countries. The World Bank, Health, Nutrition and Population (HNP) Discussion Paper 2888, <http://www.worldbank.org>.
- Knowles, J. C. and Behrman, J. R. (2005). Economic returns to investing in youth. In: *The Transition to Adulthood in Developing Countries: Selected Studies*. Washington, DC: National Academy of Science-National Research Council, 424–490.
- Kohler, H.-P. (1997). Learning in social networks and contraceptive choice. *Demography* 34(3): 369–383. <http://www.jstor.org/stable/3038290>.
- Kohler, H.-P. (2000). Fertility decline as a coordination problem. *Journal of Development Economics* 63(2): 231–263. doi:10.1016/S0304-3878(00)00118-8.
- Kohler, H.-P. (2001). *Fertility and Social Interactions: An Economic Perspective*. Oxford: Oxford University Press. <http://books.google.com/books?id=03WVNSjf1KkC>.
- Kohler, H.-P. (2010). Fertility and its implications. In: Zeng Yi (ed.). *UNESCO-EOLSS Encyclopedia of Life Support Systems: Demography*. Ramsey, Isle of Man: Eolss Publishers Co. <http://www.eolss.net>.
- Kohler, H.-P., Behrman, J. R. and Watkins, S. C. (2000). Empirical assessments of social networks, fertility and family planning programs: Nonlinearities and their implications. *Demographic Research* 3(7): 79–126. doi:10.4054/DemRes.2000.3.7.
- Kohler, H.-P., Behrman, J. R. and Watkins, S. C. (2001). The density of social networks and fertility decisions: Evidence from South Nyanza District, Kenya. *Demography* 38(1): 43–58. doi:10.1353/dem.2001.0005. <http://www.jstor.org/stable/3088287>.
- Kohler, H.-P., Billari, F. C. and Ortega, J. A. (2002). The emergence of lowest-low fertility in Europe during the 1990s. *Population and Development Review* 28(4): 641–681. <http://www.jstor.org/stable/3092783>.
- Kohler, H.-P. and Ortega, J. A. (2002). Fertility, below-replacement. In: Demeny, P. and McNicoll, G. (eds.). *Encyclopedia of Population*. MacMillan Press, vol. 1, 405–409. <http://books.google.com/books?id=hFJrPwAACAAJ&pg=PA405>.
- Kravdal, Ø. (2002). Education and fertility in sub-Saharan Africa: Individual and community effects. *Demography* 39(2).
- Kremer, M. (1993). Population growth and technological change: One million B.C. to 1990. *Quarterly Journal of Economics* 108(3): 681–716.
- La Ferrara, E., Chong, A. and Duryea, S. (2008). Soap operas and fertility: Evidence from

- Brazil. Inter-American Development Bank, Research Department, RES Working Paper #4573, <http://ideas.repec.org/p/adb/wpaper/4573.html>.
- Lam, D. (2011). How the world survived the population bomb: Lessons from 50 years of extraordinary demographic history. *Demography* 48(4): 1231–1262. doi:10.1007/s13524-011-0070-z.
- Lam, D. (2012). Perspective paper on “Population Growth” for Copenhagen Consensus 2012. Copenhagen Consensus Project 2012, www.copenhagenconsensus.com.
- Lapham, R. J. and Mauldin, W. P. (1985). Contraceptive prevalence: The influence of organized family planning programs. *Studies in Family Planning* 16(3): 117–137.
- Lee, R. and Mason, A. (2012). Low fertility and economic growth. Paper presented at the Annual Meeting of the Population Association of America, San Francisco, May 3-5, 2012, <http://paa2012.princeton.edu/download.aspx?submissionId=121596>.
- Lee, R. D. (1973). Population in preindustrial England: An econometric analysis. *Quarterly Journal of Economics* 87(4): 581–607.
- Lee, R. D. (1980). A historical perspective on economic aspects of the population explosion: The case of preindustrial England. In: Easterlin, R. A. (ed.). *Population and Economic Change in Developing Countries*. Chicago: University of Chicago Press, 517–566.
- Lee, R. D. (1986). Malthus and Boserup: A dynamic synthesis. In: Coleman, D. and Schofield, R. (eds.). *The State of Population Theory*. Oxford: Basil Blackwell, 96–130.
- Lee, R. D. (1988). Induced population growth and induced technological progress: Their interaction in the accelerating state. *Mathematical Population Studies* 1(3): 265–288.
- Lee, R. D. (2003). The demographic transition: Three centuries of fundamental change. *Journal of Economic Perspectives* 17(4): 167–190.
- Lee, R. D. (2009). New perspectives on population growth and economic development. Working Paper, University of California at Berkeley, Center on the Economics and Demography of Aging, <http://www.ceda.berkeley.edu/Publications/pdfs/rlee/UNFPANewPerspectives09.pdf>.
- Lee, R. D. (2011). The outlook for population growth. *Science* 333(6042): 569–573. doi: 10.1126/science.1208859.
- Lee, R. D. and Kramer, K. L. (2002). Children’s economic roles in the Maya family life cycle: Cain, Caldwell, and Chayanov revisited. *Population and Development Review* 28(3): 475–499.
- Lee, R. D., Lee, S.-H. and Mason, A. (2006). Charting the economic life cycle. NBER Working Paper No. 12379.
- Lee, R. D. and Mason, A. (2011). Generational economics in a changing world. *Population and Development Review* 37: 115–142. doi:10.1111/j.1728-4457.2011.00380.x.
- Lee, R. D. and Miller, T. (1991). Population growth, externalities to childbearing, and fertility policy in developing countries. In: Fischer, S., deTray, D. and Shah, S. (eds.). *Proceedings of the World Bank Annual Conference on Development Economics*. New York: World Bank, S275–S304.
- Lee, R. D. and Reher, D. S. (eds.) (2011). *Demographic Transition and Its Consequences*. Wiley-Blackwell. doi:10.1111/j.1728-4457.2011.00374.x. Supplement to *Population and Development Review*.
- Levine, R., Birdsall, N., Matheny, G., Wright, M. and Bayer, A. (2006). Contraception. In: Jamison, D. T., Breman, J. G., Measham, A. R., Alleyne, G., Claeson, M., Evans, D. B., Jha, P., Mills, A. and Musgrove, P. (eds.). *Disease Control Priorities in Developing Countries*. Oxford University Press, 35–86. 2nd edn. <http://www.dcp2.org/pubs/DCP>.
- Lomborg, B. (2012a). Family planning, better nutrition, and no more smoking: Slate

- readers weigh in on their favorite solutions to the world's biggest problems. *Slate Magazine*, Posted Monday, May 7, 2012, http://www.slate.com/articles/technology/copenhagen_consensus_2012/2012/05/copenhagen_consensus_readers_vote_for_family_planning_better_nutrition_and_tobacco_taxes_.html.
- Lomborg, B. (2012b). Is family planning the most important investment we can make? Slate readers think so. *Slate Magazine*, Posted Friday, May 4, 2012, http://www.slate.com/articles/technology/copenhagen_consensus_2012/2012/05/copenhagen_consensus_readers_say_family_planning_is_the_best_thing_we_can_do_to_help_the_poor_.html.
- Lundberg, S. and Pollak, R. A. (1996). Bargaining and distribution in marriage. *Journal of Economic Perspectives* 10(4): 139–158.
- Lyngstad, T. H. and Prskawetz, A. (2010). Do siblings' fertility decisions influence each other. *Demography* 47(4): 923–934.
- Magadi, M. A. and Agwanda, A. O. (2010). Investigating the association between HIV/AIDS and recent fertility patterns in Kenya. *Social Science and Medicine* 71(2): 335–344. doi:10.1016/j.socscimed.2010.03.040.
- Malthus, T. R. (1798). *An Essay on the Principles of Population (First Edition)*. London: J. Johnson.
- Manuelli, R. E. and Seshadri, A. (2009). Explaining international fertility differences. *Quarterly Journal of Economics* 124(2): 771–807. doi:10.1162/qjec.2009.124.2.771.
- Mason, K. O. (1997). Explaining fertility transitions. *Demography* 34(4): 443–454.
- May, J. F. (2012). *World Population Policies: Their Origin, Evolution, and Impact*. New York, NY: Springer.
- McCord, G. C., Conley, D. and Sachs, J. D. (2010). Improving empirical estimation of demographic drivers: Fertility, child mortality and malaria ecology. Columbia University: Unpublished Manuscript, <http://ssrn.com/abstract=1647901>.
- McDonald, P. (2000). Gender equity in theories of fertility transition. *Population and Development Review* 26(3): 427–440.
- McKelvey, C., Thomas, D. and Frankenberg, E. (2012). Fertility regulation and economic shocks. *Economic Development and Cultural Change* forthcoming.
- McNicoll, G. (2011). Achievers and laggards in demographic transition: A comparison of Indonesia and Nigeria. *Population and Development Review* 37(Supplement): 191–214. doi:10.1111/j.1728-4457.2011.00384.x.
- Menken, J., Duffy, L. and Kuhn, R. (2003). Childbearing and women's survival: New evidence from rural Bangladesh. *Population and Development Review* 29(3): 405–426. doi:10.1111/j.1728-4457.2003.00405.x.
- Miller, G. (2010). Contraception as development? new evidence from family planning in colombia*. *Economic Journal* 120(545): 709–736. doi:10.1111/j.1468-0297.2009.02306.x.
- Mills, E. J., Rammohan, A. and Awofeso, N. (2011). Ageing faster with AIDS in Africa. *Lancet* 377: 1131–1133. doi:10.1016/S0140-6736(10)62180-0.
- Moffitt, R. (2005). Remarks on the analysis of causal relationships in population research. *Demography* 42(1): 91–108.
- Moffitt, R. A. (2009). Issues in the estimation of causal effects in population research, with an application to the effects of teenage childbearing. In: Engelhardt, H., Kohler, H.-P. and Fürnkranz-Prskawetz, A. (eds.). *Causal Analysis in Population Studies*. Berlin: Springer Verlag, The Springer Series on Demographic Methods and Population Analysis, chap. 2, 9–29.
- Montgomery, M. R. and Casterline, J. B. (1993). The diffusion of fertility control in Taiwan: Evidence from pooled cross-section time-series models. *Population Studies* 47(3): 457–479.

- Montgomery, M. R. and Casterline, J. B. (1996). Social learning, social influence, and new models of fertility. *Population and Development Review* 22(Supplement): 151–175.
- Moreland, S., Smith, E. and Sharma, S. (2010). World population prospects and unmet need for family planning. The Futures Group, Washington, DC, <http://pubs.futuresgroup.com/3571WPP.pdf>.
- Mosher, S. (2000). AIDS and population control in Africa. *Population Research Institute Weekly Briefing* 2(16): 1–3.
- Mosher, S. (2008). *Population Control: Real Costs, Illusory Benefits*. Edison, NJ: Transaction Publishers.
- Munshi, K. D. and Myaux, J. (2006). Social norms and the fertility transition. *Journal of Development Economics* 80(1): 1–38.
- Mwaikambo, L., Speizer, I. S., Schurmann, A., Morgan, G. and Fikree, F. (2011). What works in family planning interventions: A systematic review. *Studies in Family Planning* 42(2): 67–82. doi:10.1111/j.1728-4465.2011.00267.x.
- Myrskylä, M., Kohler, H.-P. and Billari, F. C. (2009). Advances in development reverse fertility declines. *Nature* 460(7256): 741–743. doi:10.1038/nature08230.
- National Geographic Magazine (2011). Population 7 billion: There will soon be seven billion people on the planet. by 2045 global population is projected to reach nine billion. can the planet take the strain? *National Geographic Magazine*, January 2011 (by Robert Kunzig).
- National Research Council (1986). *Population Growth and Economic Development: Policy Questions*. Washington, D.C.: National Academy Press.
- Nerlove, M. (1974). Household and economy: Toward a new theory of population and economic growth. *Journal of Political Economy* 82(2): 200–218.
- Notestein, F. W. (1953). Economic problems of population change. In: *Proceedings of the Eighth International Conference of Agricultural Economists*. London: Oxford University Press, 13–31.
- Oeppen, J. and Vaupel, J. W. (2002). Broken limits to life expectancy. *Science* 296(5570): 1029–1031.
- O'Neill, B. C., Dalton, M., Fuchs, R., Jiang, L., Pachauri, S. and Zigova, K. (2010). Global demographic trends and future carbon emissions. *Proceedings of the National Academy of Sciences* 107(41): 17521–17526. doi:10.1073/pnas.1004581107.
- Osoimehin, B. (2011). Population and development. *Science* 333(6042): 499. doi:10.1126/science.1210732.
- Pence, B. W., Nyarko, P., Phillips, J. F. and Debpuur, C. (2007). The effect of community nurses and health volunteers on child mortality: The Navrongo Community Health and Family Planning Project. *Scandinavian Journal of Public Health* 35(6): 599–608. doi:10.1080/14034940701349225.
- Phillips, J. F., Bawah, A. A. and Binka, F. N. (2006). Accelerating reproductive and child health programme impact with community-based services: the Navrongo experiment in Ghana. *Bulletin of the World Health Organization* 84: 949–955. doi:10.1590/S0042-96862006001200010.
- Phillips, J. F., Simmons, R., Chakraborty, J. and Chowdhury, A. I. (1984). Integrating health services into an MCH-FP Program: Lessons from Matlab, Bangladesh. *Studies in Family Planning* 15(4): 153–161.
- Polybius (1927). *The Histories*. Cambridge, MA: Harvard University Press. Translated by W. R. Paton.
- Pop-Eleches, C. (2006). The impact of an abortion ban on socioeconomic outcomes of chil-

- dren: Evidence from Romania. *Journal of Political Economy* 114(4): 744–773.
- Population Council (2012). *Family Planning Programs for the 21st Century: Rationale and Design*. New York: The Population Council.
- Pörtner, C. C., Beegle, K. and Christiaensen, L. (2011). Family planning and fertility: Estimating program effects using cross-sectional data. World Bank Policy Research Working Paper Series No. 5812, <http://ssrn.com/paper=1934673>.
- Potter, J., Schmertmann, C. and Cavenaghi, S. (2002). Fertility and development: evidence from Brazil. *Demography* 39(4): 739–761.
- Potts, D. (2012a). Challenging the myths of urban dynamics in sub-Saharan Africa: The evidence from Nigeria. *World Development* doi:10.1016/j.worlddev.2011.12.004. Available online 21 January 2012.
- Potts, D. (2012b). *Whatever happened to Africa's Rapid Urbanization?* Africa Research Institute: Counterpoints. <http://www.africaresearchinstitute.org/files/counterpoints/docs/Whatever-happened-to-Africas-rapid-urbanisation-6PZXYPWMW7.pdf>.
- Potts, M., Gidi, V., Campbell, M. and Zureick, S. (2011). Niger: Too little, too late. *International perspectives on sexual and reproductive health* 37(2): 95.
- Prata, N. (2009). Making family planning accessible in resource-poor settings. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1532): 3049–3065. doi:10.1098/rstb.2009.0162.
- Preston, S. H. (1980). Causes and consequences of mortality declines in less developed countries during the 20th century. In: Easterlin, R. D. (ed.). *Population and Economic Change in Developing Countries*. Chicago: University of Chicago Press, 289–360.
- Pritchett, L. H. (1994). Desired fertility and the impact of population policy. *Population and Development Review* 20(1): 1–55.
- Rajaratnam, J. K., Marcus, J. R., Levin-Rector, A., Chalupka, A. N., Wang, H., Dwyer, L., Costa, M., Lopez, A. D. and Murray, C. J. (2010). Worldwide mortality in men and women aged 15–59 years from 1970 to 2010: a systematic analysis. *Lancet* 375(9727): 1704–1720. doi:10.1016/S0140-6736(10)60517-X.
- Razin, A. and Sadka, E. (1995). *Population Economics*. Cambridge, MA: MIT Press.
- Reher, D. S. (2011). Economic and social implications of the demographic transition. *Population and Development Review* 37: 11–33. doi:10.1111/j.1728-4457.2011.00376.x.
- Reniers, G., Masquelier, B. and Gerland, P. (2011). Adult mortality in Africa. In: Rogers, R. G. and Crimmins, E. M. (eds.). *International Handbooks of Population*. New York: Springer Netherlands, vol. 2, 151–170. doi:10.1007/978-90-481-9996-9_7.
- Roberts, L. (2011). 9 billion? *Science* 333(6042): 540–543. doi:10.1126/science.333.6042.540.
- Robinson, L. A. (2007). Policy monitor: How US government agencies value mortality risk reductions. *Review of Environmental Economics and Policy* 1: 283–299. doi:10.1093/reep/rem018.
- Robinson, R. S. (2012). Negotiating development prescriptions: The case of population policy in Nigeria. *Population Research and Policy Review* 31(2): 267–296. doi:10.1007/s11113-011-9222-5.
- Robinson, W. C. and Ross, J. A. (2007). *The Global Family Planning Revolution: Three Decades of Population Policies and Programs*. Washington, DC: International Bank for Reconstruction and Development & World Bank. <http://siteresources.worldbank.org/INTPRH/Resources/GlobalFamilyPlanningRevolution.pdf>.
- Rosenthal, E. (2012a). Nigeria tested by rapid rise in population. *New York Times* (Print Edition), April 14, 2012, <http://www.nytimes.com/2012/04/15/world/africa/in-nigeria-a-preview-of-an-overcrowded-planet.html>.

- Rosenthal, E. (2012b). Nigeria's population is soaring in preview of a global problem. *New York Times*, April 15, 2012, <http://query.nytimes.com/gst/fullpage.html?res=9C04E6D61530F936A25757C0A9649D8B63>.
- Rosenzweig, M. R. (1990). Population growth and human capital investments: Theory and evidence. *Journal of Political Economy* 98(5, pt. 2): 38–70.
- Rosenzweig, M. R. and Schultz, T. (1982). Child mortality and fertility in Colombia: Individual and community effects. *Health Policy and Education* 2(3–4): 305–348. doi:10.1016/0165-2281(82)90015-7.
- Rosenzweig, M. R. and Schultz, T. P. (1985). The demand for and supply of births: Fertility and its life cycle consequences. *American Economic Review* 75(5): 992–1015.
- Rosenzweig, M. R. and Wolpin, K. I. (1980). Testing the quantity-quality fertility model: The use of twins as a natural experiment. *Econometrica* 48(1): 227–240.
- Rosenzweig, M. R. and Wolpin, K. I. (1982). Governmental interventions and household behavior in a developing country: Anticipating the unanticipated consequences of social programs. *Journal of Development Economics* 10(2): 209–225. doi:10.1016/0304-3878(82)90017-7.
- Rosenzweig, M. R. and Wolpin, K. I. (1986). Evaluating the effects of optimally distributed public programs: Child health and family planning interventions. *American Economic Review* 76(3): 470–482.
- Rosenzweig, M. R. and Wolpin, K. I. (2000). Natural “natural” experiments in economics. *Journal of Economic Literature* 38(4): 827–874.
- Rosenzweig, M. R. and Zhang, J. (2009). Do population control policies induce more human capital investment? Twins, birth weight and China's “one-child” policy. *Review of Economic Studies* 76(3): 1149–1174.
- Rosero-Bixby, L. and Casterline, J. B. (1994). Interaction diffusion and fertility transition in Costa Rica. *Social Forces* 73(2): 435–462.
- Rosling, H. (2012). Religions and babies. Presentation at the TED Summit, April 2012, http://www.ted.com/talks/hans_rosling_religions_and_babies.html.
- Ross, J. and Blanc, A. (2012). Why aren't there more maternal deaths? A decomposition analysis. *Maternal and Child Health Journal* 16(2): 456–463. doi:10.1007/s10995-011-0777-x.
- Rutstein, S. (2005). Effects of preceding birth intervals on neonatal, infant and under-five years mortality and nutritional status in developing countries: Evidence from the demographic and health surveys. *International Journal of Gynecology & Obstetrics* 89(Supplement 1): S7–S24. doi:10.1016/j.ijgo.2004.11.012.
- Samuelson, P. A. (1975). The optimum growth rate for population. *International Economic Review* 16(3): 531–538.
- Schelling, T. C. (1978). *Micromotives and Macrobehavior*. New York: Norton & Co.
- Schultz, T. P. (1990). Testing the neoclassical model of family labor supply and fertility. *Journal of Human Resources* 25(4): 599–634.
- Schultz, T. P. (1994). Human capital, family planning and their effects on population growth. *American Economic Review* 84(2): 255–260.
- Schultz, T. P. (1997). The demand for children in low income countries. In: Rosenzweig, M. R. and Stark, O. (eds.). *Handbook of Population and Family Economics*. Amsterdam: North Holland, 349–433.
- Schultz, T. P. (2007). Population policies, fertility, women's human capital, and child quality. In: Schultz, T. P. and Strauss, J. A. (eds.). *Handbook of Development Economics*. Elsevier, vol. Volume 4, 3249–3303. doi:10.1016/S1573-4471(07)04052-1.

- Schultz, T. P. (2009). How does family planning promote development? evidence from a social experiment in Matlab, Bangladesh: 1977–1996. Yale University, Economic Growth Center, New Haven, Conn.
- Schultz, T. P. (2010). Population and health policies. In: Rodrik, D. and Rosenzweig, M. (eds.). *Handbooks in Economics*. Elsevier, vol. 5, 4785–4881. doi:10.1016/B978-0-444-52944-2.00010-0.
- Sedgh, G., Hussain, R., Bankole, A. and Singh, S. (2007). Women with an unmet need for contraception in developing countries and their reasons for not using a method. Guttmacher Institute, Occasional Report No. 37, <http://www.guttmacher.org/pubs/2007/07/09/or37.pdf>.
- Seltzer, J. R. (2002). *The origins and evolution of family planning programs in developing countries*. Santa Monica, CA: Rand Corporation.
- Shiffman, J. and Quissell, K. (2012). Shifting fortunes for family planning / family planning's contentious history. Paper presented at the Annual Meeting of the Population Association of America, San Francisco, May 3-5, 2012, <http://paa2012.princeton.edu/download.aspx?submissionId=120716>.
- Simmons, G. B., Balk, D. and Faiz, K. K. (1991). Cost-effectiveness analysis of family planning programs in rural Bangladesh: evidence from Matlab. *Studies in Family Planning* 22(2): 83–101.
- Simon, J. (1981). *The Ultimate Resource*. Princeton: Princeton University Press.
- Sinding, S. W. (2009). Population, poverty and economic development. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1532): 3023–3030. doi:10.1098/rstb.2009.0145.
- Singh, S., Darroch, J., Ashford, L. and Vlassoff, M. (2010). Adding it up: The costs and benefits of investing in family planning and maternal and newborn health. Guttmacher Institute Report, <http://hdl.handle.net/123456789/28189>.
- Sippel, L., Kiziak, T., Woellert, F. and Klingholz, R. (2011). Africa's demographic challenges: How a young population can make development possible. Berlin Institut für Bevölkerung und Entwicklung, <http://www.berlin-institut.org/selected-studies/africas-demographic-challenges.html>.
- Speidel, J. J., Weiss, D. C., Ethelston, S. A. and Gilbert, S. M. (2009). Population policies, programmes and the environment. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1532): 3031–3047. doi:10.1098/rstb.2009.0156.
- Stevens, J. R. and Stevens, C. M. (1992). Introductory small cash incentives to promote child spacing in India. *Studies in Family Planning* 23(3): 171–186.
- Strießnig, E. and Lutz, W. (2012). Optimal fertility. Paper presented at the Annual Meeting of the Population Association of America, San Francisco, May 3-5, 2012, <http://paa2012.princeton.edu/download.aspx?submissionId=121698>.
- Sulston, J. et al. (2012). People and the planet. Royal Society Science Policy Centre Report 01/12, <http://royalsociety.org/policy/projects/people-planet/report>.
- Summers, L. H. (1992). Investing in all the people. *Pakistan Development Review* 31(4): 367–406.
- Summers, L. H. (1994). Investing in all the people: Educating women in developing countries. World Bank, Economic Development Institute Seminar Paper No. 45, Washington, DC.
- Sunil, T. S., Pillai, V. K. and Pandey, A. (1999). Do incentives matter? Evaluation of a family planning program in India. *Population Research and Policy Review* 18(6): 563–577. doi:10.1023/A:1006386010561.

- Teller, C. and Hailemariam, A. (eds.) (2011). *The Demographic Transition and Development in Africa: The Unique Case of Ethiopia*. New York: Springer.
- The Economist (2009). Go forth and multiply a lot less: Lower fertility is changing the world for the better. The Economist print edition, October 29th, 2009, <http://www.economist.com/node/14743589>.
- The Economist (2011a). Demography: A tale of three islands—the world's population will reach 7 billion at the end of October. Don't panic. The Economist Print Edition, October 22, 2011, <http://www.economist.com/node/21533364>.
- The Economist (2011b). The hopeful continent: Africa rising—after decades of slow growth, Africa has a real chance to follow in the footsteps of Asia. The Economist (Print Edition) 3 December 2011, <http://www.economist.com/node/21541015>.
- The Economist (2011c). World population: Now we are seven billion—persuading women to have fewer babies would help in some places. But it is no answer to scarce resources. The Economist Print Edition, October 22, 2011, <http://www.economist.com/node/21533409>.
- Townsend, J. (2012). Organization and management of the supply of quality services. In: Bongaarts, J. (ed.). *Family Planning Programs For The 21st Century: Rationale And Design Reconsidered*. New York, NY: Population Council: Report to the World Bank from the Population Council.
- Turner, A. (2009). Population priorities: the challenge of continued rapid population growth. *Philosophical Transactions of the Royal Society B: Biological Sciences* 364(1532): 2977–2984. doi:10.1098/rstb.2009.0183.
- Uganda Ministry of Finance, Planning and Economic Development (2010). Uganda: Population factors and national development (rapid brief). USAID Health Policy Initiative, <http://www.healthpolicyinitiative.com/index.cfm?ID=publications&get=pubID&pubID=1068>.
- UN Millennium Development Goals (2011). The Millennium Development Goals Report. United Nations Statistical Division, <http://mdgs.un.org/unsd/mdg/Resources/Static/Data/2011%20Stat%20Annex.pdf>.
- UN Population Division (2009). What would it take to accelerate fertility decline in the least developed countries? UN Population Division Policy Brief No. 2009/1, http://www.un.org/esa/population/publications/UNPD_policybriefs/UNPD_policy_brief1.pdf.
- UN Population Division (2010a). *World Population Policies 2009*. New York: Population Division, United Nations.
- UN Population Division (2010b). World population prospects, the 2010 revision: Aids and no-aids variants. United Nations, Department of Economic and Social Affairs, Population Division, http://esa.un.org/unpd/peps/EXCEL-Data_WPP2010/aids_no-aids_variants.html.
- UN Population Division (2010c). World population prospects, the 2010 revision: Standard (median) forecasts. United Nations, Department of Economic and Social Affairs, Population Division, <http://esa.un.org/unpd/wpp/>.
- UN Population Division (2011). World contraceptive use 2011. United Nations Publication, Sales No. E.11. XIII.2, <http://www.un.org/esa/population/publications/contraceptive2011/contraceptive2011.htm>.
- UN Statistics Division (2011). Millennium Development Goals Indicators. United Nations: Millennium Development Goals Indicators—The official United Nations site for MDG Indicators, <http://mdgs.un.org/unsd/mdg/Data.aspx>.
- UNAIDS (2010). *Global report: UNAIDS report on the global AIDS epidemic 2010*. New York:

- World Health Organization and UNAIDS. <http://www.unaids.org/globalreport/>.
- UNAIDS (2011). *AIDS at 30: Nations at the crossroads*. New York, NY: United Nations Joint Program on AIDS (UNAIDS). http://www.unaids.org/unaids_resources/aidsat30/aids-at-30.pdf.
- UNFPA (2010). Sexual and reproductive health for all reducing poverty, advancing development and protecting human rights. United Nations Population Fund (UNFPA), <http://www.unfpa.org/public/home/publications/pid/6526>.
- USAID Health Policy Initiative (2009a). *Documentation: The RAPID Model—An Evidence-based Advocacy Tool to Help Renew Commitment to Family Planning Programs (Spectrum System of Policy Models)*. Washington, DC: USAID Health Policy Initiative. <http://www.healthpolicyinitiative.com/index.cfm?ID=publications&get=pubID&pubID=808>.
- USAID Health Policy Initiative (2009b). Family planning and the MDGs: Saving lives, saving resources. USAID Health Policy Initiative, <http://www.healthpolicyinitiative.com/index.cfm?ID=publications&get=pubID&pubID=788>.
- USAID Health Policy Initiative (2009c). *The RAPID Model: An Evidence-based Advocacy Tool to Help Renew Commitment to Family Planning Programs*. Washington, DC: USAID Health Policy Initiative. <http://www.healthpolicyinitiative.com/index.cfm?ID=publications&get=pubID&pubID=808>.
- USAID Health Policy Initiative (2010). The cost of family planning in Kenya. USAID Health Policy Initiative, <http://www.healthpolicyinitiative.com/index.cfm?ID=publications&get=pubID&pubID=1189>.
- Valente, T. W. and Saba, W. (1998). Mass media and interpersonal influence in a reproductive health communication campaign in Bolivia. *Communications Research* 25: 96–124.
- Valente, T. W. and Saba, W. (2001). Campaign recognition and interpersonal communication as factors in contraceptive use in Bolivia. *Journal of Health Communication* 6(4): 1–20.
- Viscusi, W. K. (1993). The value of risks to life and health. *Journal of Economic Literature* 31: 1912–1946.
- Viscusi, W. K. (2010). The heterogeneity of the value of statistical life: Introduction and overview. *Journal of Risk and Uncertainty* 40(1): 1–13.
- Weil, D. N. and Wilde, J. (2009). How relevant is Malthus for economic development today? *American Economic Review* 99(2): 255–60. doi:10.1257/aer.99.2.255.
- Wilcher, R., Cates, W. and Gregson, S. (2009). Family planning and HIV: Strange bedfellows no longer. *AIDS* 23: S1–S6. doi:10.1097/01.aids.0000363772.45635.35.
- Willis, R. J. (1973). A new approach to the economic theory of fertility behaviour. *Journal of Political Economy* 81(2, pt. 2): 14–64.
- Wilmoth, J. R. and Ball, P. (1992). The population debate in American popular magazines, 1946–90. *Population and Development Review* 18(4): 631–668.
- Wilson, C. (2004). Fertility below replacement level. *Science* 304(5668): 207–209.
- World Bank (2010). The world bank's reproductive health action plan 2010–2015. Washington, DC: The World Bank, <http://siteresources.worldbank.org/INTPRH/Resources/376374-1261312056980/RHActionPlanFinalMay112010.pdf>.
- Wulf, D. (1981). Cost-benefit and cost-effectiveness analysis for family planning programs. *International Family Planning Perspectives* 7(4): 141–144.
- Young, A. (2005). The gift of the dying: The tragedy of AIDS and the welfare of future African generations. *Quarterly Journal of Economics* 120(2): 423–466.
- Zambia Ministry of Finance and National Planning (2010). *Zambia: Population and National Development (RAPID Booklet)*. Washington, DC: USAID Health Policy Initiative. <http://www.healthpolicyinitiative.com/index.cfm?ID=publications&get=>

pubID&pubID=1179.