Why Does High African Fertility Persist?

Jack A. Goldstone, Andrey Korotayev, Sergey Shulgin and Julia Zinkina

Abstract

Sub-Saharan Africa's exceptionally slow fertility decline has been explained by both weak economic development and an unusually pro-natal culture. Yet these explanations are both too simple. SSA has shown a "stall" in its fertility decline despite recent improvements in infant mortality, education, and urbanization. Its response to development has thus been different from other developing regions. At the same time, within SSA women with higher income, living in cities, and with more education exhibit lower fertility. Thus fertility is not culturally impervious to socio-economic gains. We present a path analysis of how various modernization factors affect fertility in SSA vs. other developing regions. We find that SSA *is* different. Cultural family patterns in SSA render gains in income, urbanization, and women's paid employment ineffective in reducing fertility. Women's education is *more* effective in lowering fertility than in other regions; but SSA lags far behind other regions in educating its women.

Center for the Study of Social Change, Institutions, and Policy

Working paper No. 2-2018

Why Does High African Fertility Persist?

Most of Africa has made remarkable progress in reducing mortality, especially in recent years, as improvements in nutrition, sanitation, and measures to combat malaria and other tropical diseases have led to substantial increases in lifespans. For Africa as a whole, life expectancy in the 1950s was less than 40 years, not much different from Europe in the 1700s. But by the 1980s, life expectancy surpassed 50 years, and by 2010-2015, had reached 60 years – a 50% increase.

These gains in life expectancy were mainly due to dramatic declines in infant mortality. For sub-Saharan Africa, infant mortality has fallen by 44% in just the last two decades, from 1990-1995 to 2010-2015. The fall was quite widespread: In 1990-1995, 33 countries in sub-Saharan Africa had an infant mortality rate above 100 per thousand live births. By 2010-2015 none did, and only seven countries (Central African Republic, Chad, Somalia, South Sudan, Guinea-Bissau, Mali, and Sierra Leone) had rates above 75 (United Nations 2017).

Africa's population today is thus far healthier and longer-lived than it was in the preceding century. The UN projects that by 2050-55, average lifespans in Africa (and sub-Saharan Africa) will reach 70 years, a dramatic convergence with other world regions (United Nations 2017, medium variant projection).

Fertility: A Conundrum

Based on the experience of other developing regions, these improvements in Africa's mortality, especially infant mortality, would be expected to lead to similarly impressive reductions in fertility. In Asia and Latin America, fertility was similar to that in Africa in the 1950s, with about six children born per woman during her lifetime. Then with improvements in mortality and other indices of economic development, fertility steadily declined. By the late 1970s total fertility had fallen to four, and then by the early 2000s to well below three. As of 2010-2015, fertility in Asia and Latin America is about at replacement levels, at 2.2 and 2.1 respectively. Yet in Africa, a wholly different pattern developed.

From the 1950s fertility in Africa actually rose slightly, reaching nearly seven children per woman by the early 1970s. Fertility then sharply diverged in different regions. In northern and southern Africa, fertility began a steady decline.[1] In northern Africa, fertility fell from seven children per woman in the 1960s to five by the late 1980s, and then to three by 2005-2010. In southern Africa, where fertility was six children per woman in the 1960s, the level fell to four in the late 1980s and to less than three by 2005-2010. These regions thus followed the pattern of other developing regions, with about a one-decade delay.

By contrast, in eastern Africa in the late 1980s fertility was still above seven children per woman. It then began a slow decline but still remains at nearly five in 2010-2015. In middle Africa, which had fertility of about six children per woman in the 1950s, fertility continued to *rise* all the way up through the late 1980s, reaching 6.76 in 1985-1990. Fertility then began to decline but very slowly, remaining at about six children per woman even twenty-five years later in 2010-2015. Western Africa was similar to middle Africa, with fertility rising and remaining close to seven children per woman up to the late 1980s, then falling slowly, but a bit further than in middle Africa, reaching 5.5 by 2010-2015. Western, middle and eastern Africa have thus shown a dramatically different fertility path than other parts of Africa and other

regions of the developing world. These are the only large regions of the world where even after decades of falling mortality fertility remains at or above five children per woman (United Nations 2017).

As Jean-Pierre Guengant and John F. May (2013, 255) have stated, "This pattern of persisting high levels of fertility in the majority of African countries differs markedly from what has been observed in other developing countries since 1960." Yet as John Casterline (2017, 4) recently observed, "there is nothing approaching consensus on the sources of this difference."

Why High African Fertility Persists

John Bongaarts (2017, 40), summing up the experience of most developing regions, notes that "As societies modernize, economic and social changes such as industrialization, urbanization, new occupational structure, and increased education lead first to lower mortality and subsequently to a decline in fertility." Accordingly, at the 1974 United Nations population conference in Bucharest, India's minister of population Karan Singh famously claimed that "Development is the best contraceptive." Yet in tropical Africa this has not been the case. For sub-Saharan Africa as a whole, real GDP/capita has grown by 50% from 1995 to 2015 (World Bank 2018). Yet even as most countries in this region have experienced real income gains, urbanization, greater literacy, and economic growth, high fertility rates persist.

The puzzle as to why these changes have not produced lower fertility in Africa, as they have done elsewhere, has given rise to two main answers: First, it is true that Africa has not yet experienced the same increases in education, income, and other indices of modernization that have been seen in Asia and Latin America. As Bongaarts (2017) notes, real income per capita in sub-Saharan Africa grew hardly at all from the 1970s to the 2010s, while real income in other developing regions rose sharply in these decades. Goujon, Lutz, and Samir (2015) have pointed out that many sub-Saharan countries had a "stall" in their progress in education that may have produced a "stall" in progress in reducing fertility. Thus it could be posited that Africa is simply behind in certain attainments and will eventually catch up to other regions.

Yet this is unsatisfactory for two reasons. First, northern and southern Africa did in fact follow the pattern of other regions, as would be expected; it is only eastern, middle, and western Africa that have not done so. Second, even for the latter regions, the rate and amount of their fertility decline is not comparable to what happened in other developing regions at similar levels of income and development (Shapiro and Hinde 2017; Shapiro and Gebreselassie 2008; Ezeh, Mberu and Emina 2009). According to Bongaarts and Casterline (2012, 155), "… the median pace of change in sub-Saharan Africa (0.03 per year) is less than one-third the pace in the other regions [Asia and Latin America] (0.12 and 0.13, respectively)." Indeed, the behavior of fertility in sub-Saharan Africa is wholly at odds with the idea that economic progress determines the pace of fertility decline. As Bongaarts (2017) has shown, fertility rose when the region's GDP/capita was relatively high in the 1970s, then began the onset of fertility decline in the early 1990s, when GDP/capita had fallen considerably, and then encountered a widespread stall in fertility decline in the 2000s, when GDP/capita was rising fairly rapidly.

Forecasting of Africa's demographic trajectory based on expectations that it would follow the pattern of other regions has thus been badly misleading. Figure 1 below shows the difference between the decline

in fertility from 1990-1995 to 2010-2015 projected by the United Nations Population Division in 1995 and the actual decline in fertility as revealed by on-the-ground Demographic and Health Surveys (DHS) two decades later. As can readily be seen, the UN fertility projections for most of the countries of sub-Saharan Africa, based on analyzing the pattern of fertility decline in other developing regions, anticipated fertility reductions of .5 to 1 child per woman more than was actually observed.

As the slow fertility decline in Africa continues to confound expectations, the adjustments to population projections can be dramatic. Table 1 shows how the UN's projections for Africa's poppulation in 2050 have changed from the 2010 Revision of World Population Prospects (United Nations 2011), to the 2017 revision (United Nations 2017). The differences – due to an expected decline in fertility that simply did not occur – are striking. The 2017 "medium variant" projection for the population of sub-Saharan Africa in 2050 is higher by 337 million people (15.4%) than the projection made just six years earlier. For some regions, the new projections are almost thirty to forty percent higher. Indeed, the new 2017 "medium variant" forecasts are closer to the 2010 "high variant" forecasts, and sometimes exceed them. The new "high variants" have been similarly adjusted upwards. If, as has occurred to date, the "high variant" projections become the new "medium" projections, the future medium forecast population for Africa in 2050 would be almost 2.8 billion, or 600 million more than the 2010 medium forecast of 2.2 billion.

Figure 1. UN Projections of Fertility Decline 1990-1995 to 2010-2015 vs. DHS reported Fertility Decline

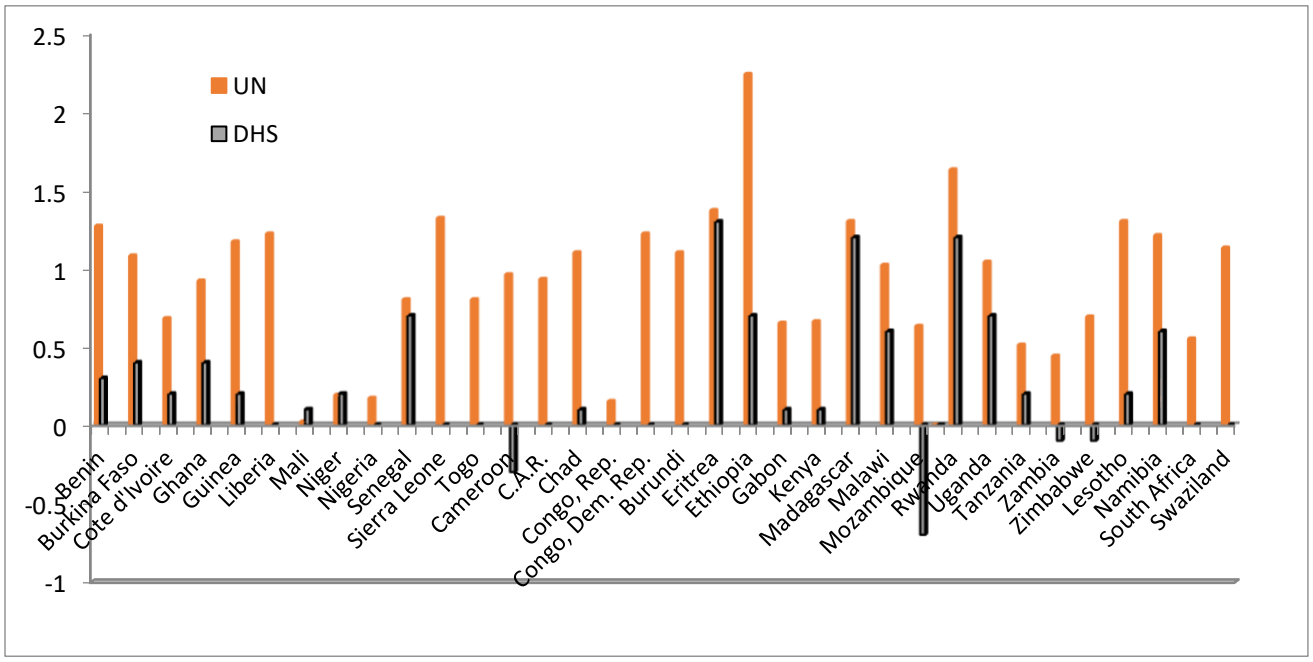


Table 1. UN POPULATION PROJECTIONS FOR 2050 (Millions), 2010 Revision vs. 2017 Revision

	Medium Variant Projections			**High Variant Projections**		
	2010	*2017*	*Increase*	*2010*	*2017*	*Increase*
AFRICA	2191	2528	15.4%	2470	2786	12.8%
Eastern Africa	780	888	13.8%	879	982	11.7%
Middle Africa	278	384	38.1%	314	420	33.8%
Northern Africa	322	360	11.8%	368	399	8.4%
Southern Africa	67	86	28.4%	79	97	22.8%
Western Africa	744	810	8.9%	830	887	7.0%

Because of the failure of Africa's fertility to track the pattern of other regions, an alternative hypothesis has been advanced, arguing that Africa has an exceptionally pro-natalist culture that maintains high fertility even in the face of economic modernization. John and Pat Caldwell (1987), who have led this line of argument, point to the exceptionally high desired family size that appears in African surveys. It has also been noted that in Africa, due to traditional taboos on post-partum intercourse and long breast-feeding periods, birth spacing was historically relatively high. This means that there is both less room to lower fertility by increasing birth spacing, and more room to increase fertility by reducing birth spacing if these traditional practices are relaxed (Lesthaeghe 1980; Benefo 1995).

While this explanation would account for the low rate of fertility decline observed in Africa, and even the rise in fertility observed from the 1950s to the 1970s, it too has difficulties. In fact, we do observe a gradient in fertility within sub-Saharan Africa linked to modernization indices. Women in cities, and women having higher education and higher incomes, generally have lower fertility than women in rural areas, and with lower education and lower incomes (Bongaarts 2010; Guengant and May 2013). Modernization factors thus have an effect on fertility in Africa, just not quite in the same fashion as in other developing regions.

A more likely answer would be an interactive combination of modernization levels and cultural factors, such that certain regions of Africa – western, middle, and eastern Africa – have distinctive cultural patterns that affect the impact of economic development on fertility. That is, as Bongaarts (2017, 40) has argued, "the response of fertility to development could be fundamentally different in Africa than elsewhere in the developing world."

We test this hypothesis with a path analysis of how modernizing factors affect fertility in Africa vs. other developing regions.

Africa is different

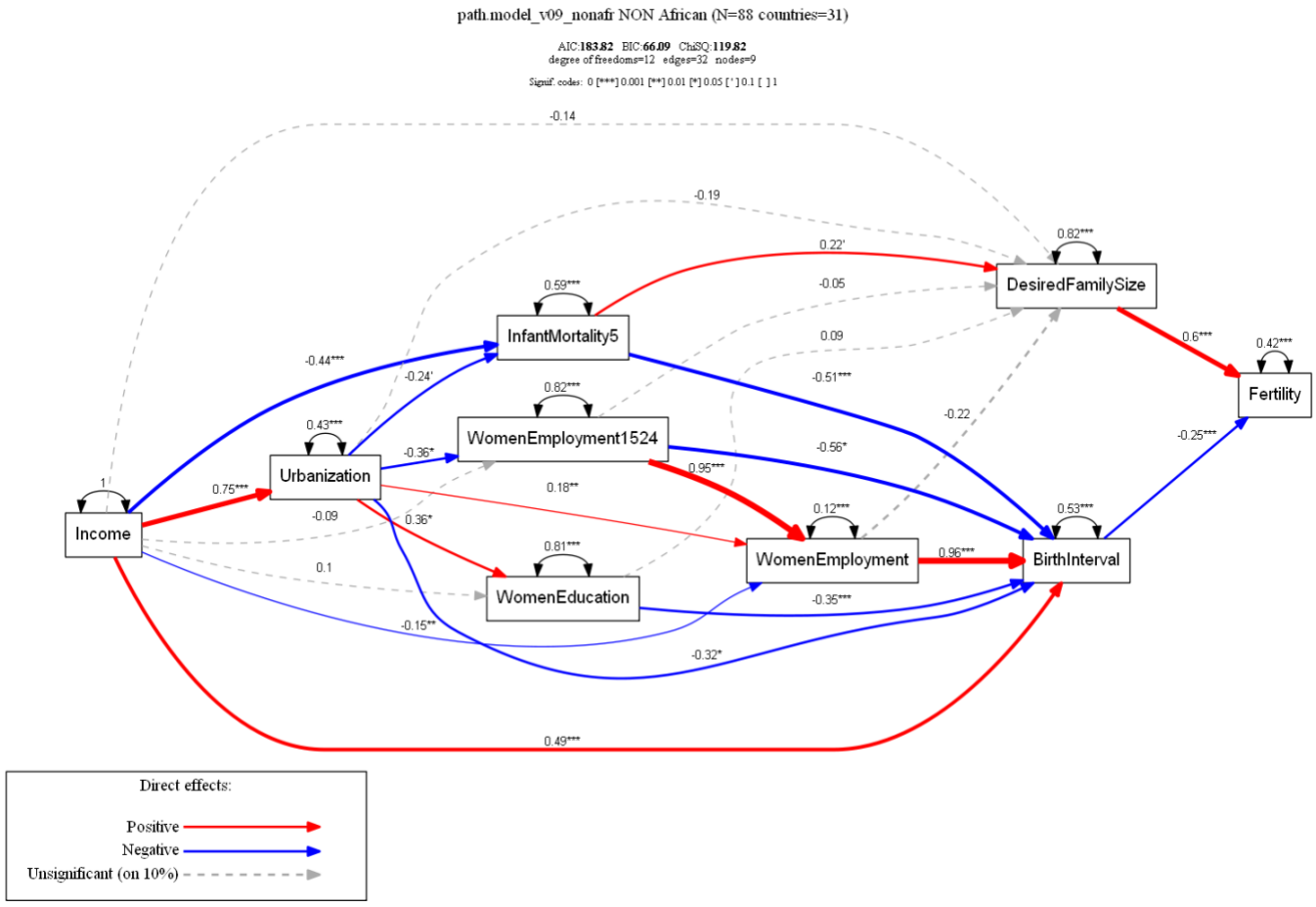
John Bongaarts (2017) has found that while fertility in African countries generally declines in line with changes in income, education, mortality, and urbanization, in a multiple regression including all of these factors only education was consistently significant in driving fertility, contraceptive use and desired family size. In addition, he found an "Africa effect" such that for any level of development indicators, fertility was about one child per woman higher than in other developing regions. He thus concluded that both the level of economic development (especially education) *and* a distinctive pro-natal culture in sub-Saharan Africa contribute to Africa's unique fertility dynamics.

The finding that education was the most consistently significant factor supports the suggestion by Goujon, Lutz and Samir (2015) that Africa's "fertility stall" reflects a lack of progress in educational attainments. It is also consistent with Shapiro et al.'s (2013) finding from DHS surveys that progress in women's education is more important than gains in income per head in accelerating fertility decline. We thus frame our model to examine how various development factors, including women's education, act directly and indirectly to influence fertility.

In Figure 2, we show a path model for the determinants of fertility in developing countries *excluding* sub-Saharan Africa. This is based on data available from Demographic and Health Surveys (DHS) for 31 countries at various time intervals from 1991 through 2013, making up 88 observations. The model follows the distinction made by Guegant and May (2013) between *intermediate* determinants of fertility, which are mainly socioeconomic conditions that influence fertility indirectly, and *proximate* determinants of fertility, which are mainly biological and behavioral and influence fertility directly. The intermediate determinants exert their influence on fertility through their effect on the proximate determinants. In the model, the intermediate determinants are income (real GDP/capita), urbanization (percent urban), infant mortality, women's employment (both for young women age 15-24 and all women), and women's education. The proximate determinants are desired family size and birth interval, which together shape total fertility (Pritchett 1994; Caldwell and Caldwell 2002; Caldwell, Orubuloye and Caldwell 1992; Casterline and Agyei-Mensha 2017; Casteline and Odden 2016; Moultrie, Sayi and Timaeus 2012).

In the path model, positive effects are shown by red arrows, negative effects by blue ones, with the strength of the effect shown by the thickness of the arrow. Non-significant effects are shown as dotted arrows. In this model, fertility is affected most strongly by desired family size, though the effect of birth interval is also highly significant. The effects are almost all as one would expect from the development literature. Rising incomes lead to lower infant mortality, and have a direct effect on increasing birth intervals, thus reducing fertility. Rising income also leads to greater urbanization, which is associated with higher levels of women's education and women's employment (both for young women and all ages), and also has a direct effect on increasing birth intervals. Lower infant mortality leads to a reduction in desired family size, which greatly reduces fertility. In addition, lower infant mortality, women's employment, and women's education all also contribute to rising birth intervals; indeed these

Figure 2: Path Model for Fertility in non-African developing countries



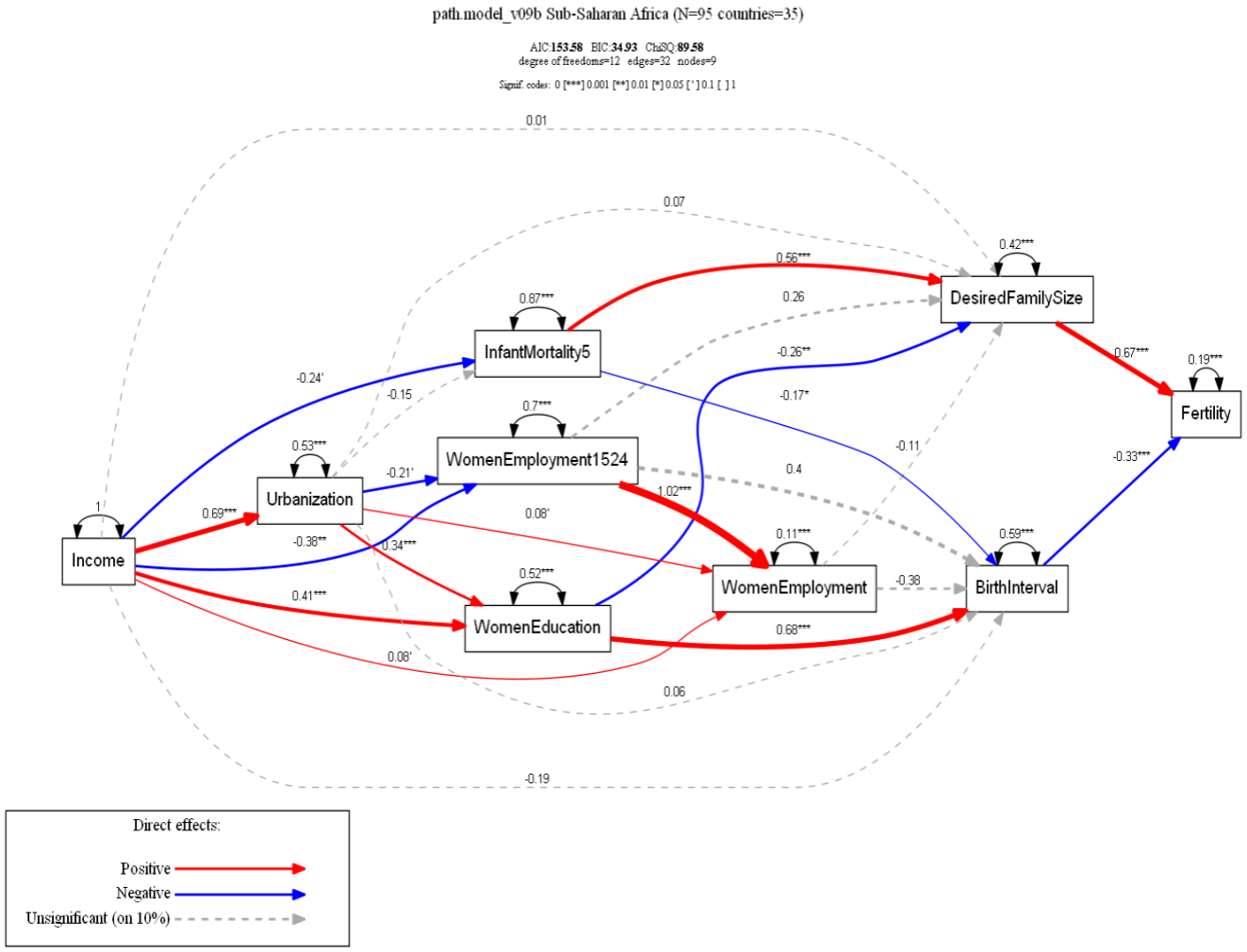
---

factors seem to impact fertility entirely through greater spacing of births rather than changes in desired family size. Still, the overall pattern is familiar – as incomes rise, urbanization and women's education and employment rise as well, and all of these factors produce a decline in desired family size and increases in birth spacing, producing lower fertility.

If we run the same path analysis on African countries, we would perhaps expect, following Bongaarts, that these relationships would still obtain but be weaker, or that, following Goujon, Lutz and Samir, that education would have a larger impact. The model using data from DHS surveys in 35 countries in sub-Saharan Africa, with 95 observations from 1991 through 2013, is shown in Figure 3. In fact, there are some surprising and marked differences from the relationships in Figure 2.

Regarding similarities, in sub-Saharan Africa rising income does lead to both higher urbanization and lower infant mortality, although the latter effect is much weaker in Africa. Lower infant mortality, in turn, has a somewhat stronger effect on reducing desired family size in Africa than in other developing countries, but a much weaker effect on birth intervals. Higher urbanization is associated with higher

Figure 3. Path model for fertility in sub-Saharan African countries



women's education and employment, in much the same magnitude of effect in Africa as in other developing regions.

However, there are huge differences in the results of women's education and women's employment. Outside of Africa, many factors contribute to larger birth intervals, and hence to reduced fertility—lower infant mortality, higher income, women's education, young women's employment, total women's employment, and urbanization all have direct effects. The largest of those effects are through women's employment, both for young women and total women. But in sub-Saharan Africa, the most powerful factor driving changes in the birth interval is women's education. Women's employment–whether for young women or for all women—has no statistically significant impact at all! Moreover, in sub-Saharan Africa, but not other developing regions, women's education also has a significant direct impact on desired family size. Also unusual is that in sub-Saharan Africa, unlike other developing regions, gains in income and urbanization have no direct effect on birth intervals at all; rather they act only indirectly through increasing women's education.

In sum, Africa *is* different. In other developing regions, a cluster of modernizing changes work in tandem, reinforcing changes that stretch out birth intervals and thus reduce fertility. Most important is getting women into the workplace. Women's education, however, has only a minor impact on birth intervals and none on desired family size. In sub-Saharan Africa, by contrast, women's education is absolutely central, as it is the most important driver of changes in birth intervals and a strong direct factor in reducing desired family size. By contrast, women's employment has no significant effect at all on fertility, not through family size nor through birth intervals.

How is this possible? In most developing countries, as women move into paid work outside the home—including young women with modest education—fertility is reduced as they have to choose between spending more time working and earning income and staying home to take care of their children. Women's employment thus has a strong impact on fertility. However, in Africa extended family child-care systems have developed that allow women to avoid this trade-off. The basic commitment enabling this pattern is the cultural expectation that aunts, uncles, siblings, grandparents, cousins, and even co-wives (where polygyny occurs) will take care of children while their mothers work. As Korotayev et al. (2016, 259) note:

> As long as extended families provide working women (not only agricultural workers, but ones in urban areas having paid employment as well) with relatives who are willing to come and assist with household tasks and child care, paid female employment may not only make a far smaller contribution to fertility decline in tropical Africa than that observed in other regions, but it may also actually delay fertility reduction in Africa by slowing the trend toward the nuclear family system.

Korotayev et al. argue that the "right" to extended family childcare is rooted in long-standing cultural patterns distinct to tropical Africa. They note that this region (corresponding to eastern, middle and western Africa) was characterized by hoe-based agriculture, in which women were the primary daily field workers, as opposed to the plow-based agriculture that prevailed in north Africa, Europe and Asia. In the latter regions, men were the primary field workers, while women worked at textile and other domestic tasks that were undertaken inside the home, and combined with child care. Tropical Africa thus commonly has extended families with widespread polygyny and large desired family size, all of which facilitate women working outside the home. When women shift to paid work outside the home this pattern simply continues and allows women to enter paid labor without worrying about child care (Koratayev et al. 2016: 258-262; Ware 1977). These cultural patterns buffer the effect of women's employment on childbearing. Women's employment thus should have no impact on birth spacing or fertility in tropical Africa, which is exactly what we find in the path model.

The factor that is central to fertility decline in Africa, more than any other, thus appears to be women's education. It is only through their effects on this factor that other development changes seem to matter, as shown by both the path analysis in Figure 3 and Bongaart's (2017) multiple regression showing that when total fertility, contraceptive prevalence, and desired family size are regressed on education, income, life expectancy and urbanization, only education is consistently significant. To understand future fertility in Africa, we thus need to take a closer look at its progress in education.

Africa's secondary education deficit

It is widely known that there are problems in the quality of education in developing nations. Teachers do not show up for classes, educational materials go missing, and effective testing, feedback, and cumulative growth in skills are often lacking (Pritchett 2013). These problems are not unique to tropical Africa; they are found in many developing nations, especially in south Asia, where fertility has nonetheless declined. Yet in other regions, educational progress is far less important for fertility decline than in sub-Saharan Africa. As we have just seen, in most developing countries women's education has a far smaller impact on fertility than women's employment; in sub-Saharan Africa is it the other way around.

This would suggest an opportunity for rapid fertility reduction in Africa by investing in women's education. Yet Africa has, despite substantial increases in schooling in recent decades, apparently invested in the wrong kind of education for fertility reduction. That is, Africa has invested mainly in primary education, leaving a great deficit in secondary education. Moreover, such secondary education as is provided often goes more to boys, with women's access lagging.

For women, it appears that secondary education is the critical arena for reducing fertility. Women who leave school after primary education, which ends at age 12, are readily available for very early marriage, and have no distinctive skills that allow them to be more productive or stand up to their husbands. Women who complete high school, by contrast, are unlikely to marry before age 18, and emerge with greater confidence and skills that allow them to shape their own fertility and make a greater economic contribution to their families (Jejeebhoy 1995).

Moreover, as Véronique Hertrich (2017) has argued, women in Africa face particular difficulties in asserting their choices about their reproductive behavior. Women in Africa often are married while young to much older men, or have to compete with co-wives in polygamous marriages. In either case, they are ill placed to make demands about shaping family size. In addition, the extended family child-support system also carries with it pressure from the extended family to have a larger family size, since in conditions of great uncertainty and rare opportunities, a larger family has valuable risk-spreading benefits for the entire extended family. The benefits of larger families, as well as the costs, are thus spread over a large extended family grouping, rather than the spousal couple (Hertrich 2017; Johnson-Hanks 2012; Mbacké 2017). Completing secondary education makes it possible for young women to have the skills and confidence to assert themselves against these pressures, and gain the ability to limit their childbearing if they choose to do so.

Joel Cohen (2008, 572) has forcefully made the case for the effects of secondary education in high fertility societies. He writes:

> Although there are other factors at work, in many developing countries, women who complete secondary school average at least one child fewer per lifetime than women who complete primary school only. In Niger in 1998, for example, women who completed secondary education had 31% fewer children (on average, 4.6 per lifetime) than those who completed only primary education (6.7). In Yemen in 1997, women who completed primary school had 4.6 children on average whereas women who completed secondary school had 3.1 children on average. In some sub-Saharan African societies,

lifetime fertility is reduced only among girls who have had 10 or more years of schooling.

Despite its importance, the data on secondary school enrollments in tropical Africa tells a disappointing story. Overall, net secondary attendance for females in sub-Saharan Africa is only 34%; that is one-half the level in the Middle East and North Africa, and one-quarter less than in South Asia. Table 2 provides a sample of primary and secondary enrollment rates for females in major countries of tropical Africa (UNICEF 2018).

As is clear, while considerable progress has been made in female primary education, there is a substantial gap when it comes to female's secondary education. Even in countries where female primary attendance is over 80%, such as Tanzania, Burundi, Uganda and Rwanda, female secondary attendance falls to 25% or less. Across all these countries, female enrollment ratios never reach even 50%.

To be sure, female education is not a necessary and sufficient condition for fertility decline. Kenya and Rwanda both have similar levels of fertility, 4.1 and 4.2 respectively, even though Kenya has almost

---

Table 2. Africa's Secondary Education Gap

	Female Net Attendance Ratio	
	Primary Education	Secondary Education
Niger	46	13
Burkina Faso	50	17
Nigeria	66	49
Ethiopia	67	18
Sudan	67	45
Central African Rep.	68	15
Angola	76	17
Tanzania	83	25
Burundi	84	14
Dem. Rep. Congo	85	41
Kenya	87	44
Uganda	87	21
Malawi	95	34
Rwanda	96	23

twice the level of female secondary attendance. In Rwanda, a vigorous state-led campaign to promote contraception and legal limits on teenage marriage have had roughly the same effect as Kenya's greater progress on female education. Yet on average, female education is the single most important factor in reducing fertility in tropical Africa. And tropical Africa severely lags other developing regions in providing women with secondary education.

Conclusion

In sum, the reason that tropical Africa continues to have extraordinarily high fertility is rooted in both this region's distinctive extended family culture and its deep deficiency in secondary education. Unless the latter is addressed, we can expect that even continued growth in primary education, urbanization, and income per head will have only minor effects on reducing fertility. Given the rapid decline in mortality that Africa has enjoyed, and the still high fertility that it maintains, the future will be one of extremely rapid population growth.

For over forty years, a debate has raged over policies to reduce fertility as to whether "contraception is the best contraceptive" or "development is the best contraceptive." While there are examples of family planning policies in diverse regions that have had success, as in Iran and Rwanda, and development has encouraged fertility decline in many areas, our analysis suggests that tropical Africa is different. In this region, neither principle may be valid. Rather, "women's education is the best contraceptive" appears to be the operative relationship.

REFERENCES

Benefo, Kofi D. 1995. "The determinants of the duration of postpartum sexual abstinence in West Africa: A multilevel analysis," *Demography* 32(2): 139-157.

Bongaarts, John. 2010. "The causes of education differences in fertility in sub-Saharan Africa," Working Paper No. 20, The Population Council, New York.

----------. 2017. "Africa's Unique Fertility Transition," *Population and Development Review* 43 (Suppl.): 39-58.

Bongaarts, John and John B. Casterline. 2013. "Fertility transition: Is sub-Saharan Africa different?," *Population and Development Review* 38 (Suppl.): 153–168.

Cohen, Joel. 2008. "Make secondary education universal," *Nature* 456 (4): 572-573.

Caldwell, John C. and Pat Caldwell. 1987. "The cultural context of high fertility in sub-Saharan Africa," *Population and Development Review* 13(3):409–437.

----------. 2002. "Africa: the new family planning frontier," *Studies in Family Planning* 33(1): 76–86.

Caldwell, John C., I.O. Orubuloye and Pat Caldwell. 1992. "Fertility decline in Africa: A new type of transition?," *Population and Development Review* 18 (2): 211–242.

Casterline, John B. 2017. "Prospects for Fertility Decline in Africa," *Population and Development Review* 43 (Suppl.): 3-18.

Casterline, John B. and Samuel Agyei-Mensah. 2017. "Fertility desires and the course of fertility decline in sub-Saharan Africa," *Population and Development Review* 43 (Suppl.): 84-111.

Casterline, John B. and Colin Odden. 2016. "Trends in inter-birth intervals in developing countries, 1965–2014," *Population and Development Review* 42(2): 173–194.

Ezeh, Alex, Blessing Mberu, and Jacques Emina. 2009. "Stall in fertility decline in Eastern African countries: Regional analysis of patterns, determinants and implications," *Philosophical Transactions Royal Society B* (364): 2991–3007.

Goujon, Anne, Wolfgang Lutz and K.C. Samir. 2015. "Education stalls and subsequent stalls in African fertility: A descriptive overview," *Demographic Research* 33(47): 1281-1296.

Guengant, Jean-Pierre and John F. May. 2013. "African demography," *Global Journal of Emerging Market Economies* 5(3): 215-267.

Jejeebhoy, Shireen J. 1995. *Women's Education, Autonomy, and Reproductive Behaviour: Experience from Developing Countries*, Oxford: Clarendon Press.

Johnson-Hanks, Jennifer. 2007. "Natural intentions: Fertility decline in the African Demographic and Health Surveys," *American Journal of Sociology* 112 (4): 1008–1043

Hertrich, Véronique. 2017. "Trends in age at marriage at the onset of fertility transition in sub-Saharan Africa," *Population and Development Review* 43 (Suppl.): 112-137.

Korotayev, Andrey, Julia Zinkina, Jack A. Goldstone and Sergey Shulgin. 2016. "Explaining current fertility dynamics in tropical Africa from an anthropological perspective: A cross-cultural investigation," *Cross Cultural Research* 50(3): 251-280.

Lesthaeghe, Ron. 1980. "On the social control of human reproduction," *Population and Development Review* 6(4): 527-548.

Mbacké, Cheikh. 2017. "The persistence of high fertility in sub-Saharan Africa: A Comment," *Population and Development Review* 43(Suppl.): 330-337.

Moultrie, Tom, Takudzwa S. Sayi and Ian M. Timæus. 2012. "Birth intervals, postponement, and fertility decline: A new type of transition?," *Population Studies* 66(3): 241–258.

Pritchett, Lant. 1994. "Desired Family Size and the Impact of Population Policies," *Population and Development Review* 20(1): 1-55

----------. 2013. *The Rebirth of Education: Schooling Ain't Learning,* Washington D.C.: Center for Global Development.

Shapiro, David and Andrew Hinde. 2017. "On the pace of fertility decline in sub-Saharan Africa," *Demographic Research* 37: 1327-1338.

Shapiro, David and Tesfayi Gebreselassie. 2008. "Fertility transition in sub-Saharan Africa: Falling and stalling," *African Population Studies* 23(1): 3–23.

Shapiro, David, Amanda Kreider, Catherine Varner, and Malika Sinha. 2013. "Stalling of fertility transitions and socioeconomic change in the developing world: Evidence from the Demographic and Health Surveys," in Dominique Tabutin and Bruno Masquelier (eds.), *Ralentissements, résistances et ruptures dans les transitions démographiques, Actes de la Chaire Quetelet 2010*, Louvain-la-Neuve, Belgium, Presse de l'Université de Louvain, pp. 47–64.

United Nations. Department of Economic and Social Affairs, Population Division. 2011. World Population Prospects, the 2010 Revision. New York: United Nations.

----------, 2018. World Population Prospects, the 2017 Revision. New York: United Nations.

UNICEF. 2018. Global Databases, Education overview. New York: UNICEF. https://data.unicef.org/topic/education/overview/

Ware, Helen. 1977. "Women's work and fertility in Africa," in S. Kupinsky (ed.), *The Fertility of Working Women.* New York, NY: Praeger, pp. 1-34.

World Bank, Constant GDP per capita: All Income Levels for Sub-Saharan Africa [NYGDPPCAPKDSSF], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/NYGDPPCAPKDSSF, December 21, 2018.

[1] The UN Population Division divides Africa into five regions: northern, western, middle, eastern and southern. When data is given for these regions, it is drawn from the United Nations (2017), which gives population-weighted totals for each region.