Fertility Transition in Sub-Saharan Africa: Falling and Stalling*

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Introduction

During the 1960s, 1970s, and 1980s, as fertility decline spread throughout much of the Third World, sub-Saharan Africa was distinguished as the only major region in the world without any indication of onset of fertility transition (Lesthaeghe, 1989a). A substantial literature emerged that discussed the various social, cultural, and economic factors that served to maintain fertility at high levels in Africa south of the Sahara.

By the beginning of the 1990s, however, it began to be apparent that change was taking place, and that fertility in at least a few African nations was beginning to fall. Over the past 15 years, several studies have documented, first, the spread of fertility transition throughout the region (Tabutin, 1997; Cohen, 1998; Tabutin and Schoumaker, 2001; Garenne and Joseph, 2002; Shapiro and Tambashe, 2002; Shapiro et al., 2003), and more recently, the stalling of the transition in some countries that had been at the forefront of fertility decline in sub-Saharan Africa (Bongaarts, 2005; Westoff and Cross, 2005).

This paper uses data from the numerous Demographic and Health Surveys that have been carried out in sub-Saharan Africa to examine the current status of fertility transition in the region, including the extent to which fertility decline has stalled; to study the links between changes in contraceptive use, fertility preferences, and socioeconomic development (as reflected in changes in women's education, infant and child mortality, and real per-capita economic growth) and fertility decline and stalling; to analyze determinants of age-specific fertility rates in urban and rural areas; and to assess future prospects for fertility decline in the region. We focus on survey results from the 24 countries that have had multiple Demographic and Health Surveys, since these data, representing more than three-quarters of the region's population, provide direct evidence on fertility transition within individual countries.

In his analysis of the causes of stalling fertility transitions, Bongaarts (2005, Table 1) provides an overview of national total fertility rates (TFRs) in recent DHS surveys in 38 countries, half of which are from sub-Saharan Africa. Among these 19 African countries, two are identified as stalled (Ghana and Kenya), 12 show a declining trend, and the remaining five cases are essentially considered as either pre-transitional or in the early stages of fertility transition. Bongaarts focuses on countries experiencing a stall in fertility in mid-transition, where stall is defined operationally as a failure of the national TFR to decline between the two most recent DHS surveys, and mid-transition refers to countries in which the TFR has fallen to at least 5 as of the most recent survey.

Our approach, with an expanded set of countries and results from several more recent surveys, is similar to that of Bongaarts in that we focus on changes in national TFRs between the two most recent DHS surveys in order to distinguish falling from stalling fertility, and we compare fertility determinants in the stalling countries with those in nations in which fertility decline is ongoing. However, we also identify and analyze behavior in several countries that appear to be experiencing stalling in early stages of fertility transition. That is, we distinguish mid-transition stalls from early-transition stalls. In addition, reflecting our own previous work (Shapiro and Tambashe, 2002; Shapiro et al., 2003) as well as work by Garenne and Joseph (2002), we examine TFRs not only at the national level but also separately for urban and rural places. Indeed, not unlike elsewhere, fertility transition in sub-Saharan Africa is first manifested in urban places, prior to being evident in rural areas. We then look at contraception, fertility preferences, and socioeconomic development and how they are linked to fertility decline and stalling fertility.

The first substantive part of the paper, then, consists of an up-to-date assessment of the fertility transition in sub-Saharan Africa, using the latest available data from the Demographic and Health Surveys. As noted, we focus on those countries that have been covered by multiple DHS surveys. In some of these countries (e.g., Kenya, Ghana, Cameroon) it is apparent from the most recent surveys that the declines in fertility that had been realized during the 1990s seem to have halted, and a certain stability in the overall level of fertility has emerged, at least for the time being. Whether these stalls will be temporary or longer-lasting remains to be seen.

In the second substantive section of the paper, we examine factors presumed to be contributing to fertility decline and fertility stall in sub-Saharan Africa. Among the African countries, do differences in contraceptive use or in fertility preferences help account for which countries are experiencing stalling? Bongaarts (2005, p. 2) noted that "[t]he stalls appear to be attributable at least in part to a lack of recent progress in socioeconomic development in Ghana and Kenya." More broadly, as Bongaarts and Watkins (1996) and Bongaarts (2002) have noted, levels of socioeconomic development at which fertility decline is initiated appear to have declined over time. Sub-Saharan Africa's overall development level has been low, and countries in the region may consequently be especially susceptible to stalling of fertility decline. At the same time, however, there is certainly variation in the pace of development across countries. Within the African context, can differences in socioeconomic development help explain falling and stalling fertility? For example, has slowing of progress in augmenting women's educational attainment contributed to stalling of fertility transition? Likewise, following Bongaarts, we examine the impact of changes in infant and child mortality and changes in real GDP per capita on fertility decline.

The concluding substantive part of the paper presents multivariate regression analyses of the age-specific fertility rates of urban and rural women and of key proximate determinants of fertility. These analyses seek to identify factors contributing to differences in fertility levels and changes. Our earlier work on fertility transition in the region emphasized the importance of women's education in contributing to fertility decline, both directly and via the proximate determinants of marriage and contraceptive use, as well as via the influence of education on infant and child mortality. We explore the robustness of these earlier conclusions in the face of new data including stalling experience, and with additional countries. The paper concludes with a discussion regarding the future of fertility transition in the region.

Fertility Transition in Sub-Saharan Africa

An overview of fertility transition in sub-Saharan Africa is provided by the data in Table 1, which gives national total fertility rates as well as those for rural and urban places for each DHS survey where there have been multiple DHS surveys.[1] For each country, the table also identifies the trend in fertility, based on examination of the national TFR in the two most recent surveys.

As shown in Table 1, we find that stalling of fertility transition characterizes seven of the 24 countries, while 14 countries show a declining trend and the remaining three countries may be

[1] One exception here is the 1999 DHS for Nigeria. Concerns about data reliability prompted us to exclude results from that survey.

characterized as pre-transitional.[2] The seven countries identified as experiencing stalling include three that fit the mid-transition classification used by Bongaarts (Cameroon has been added to Ghana and Kenya), and four others that are at an earlier stage in their fertility transitions, with national TFRs in the neighborhood of 5.5 to 6 and no decline or an increase in the national TFR between the two most recent surveys (Guinea, Mozambique, Rwanda, and Tanzania).[3] As compared to Bongaarts (2005), then, we point to a greater incidence of stalling, primarily because of the less restrictive definition of stalling that we have used in order to identify cases of early stalling.

At the same time, most countries continue to experience fertility decline. This is a heterogeneous group with respect to fertility change, including both countries where the most recent declines in fertility have been substantial (e.g., Eritrea, Namibia, and Togo) as well as countries in which fertility at the national level has declined but rather modestly (e.g., Chad, Cote d'Ivoire, and Ethiopia). Finally, the pre-transitional countries are those in which the national TFR is on the order of 7, and where there has been little or no decline across surveys. Figure 1 shows the 7 stalling countries and the 14 declining nations, ordered by the size of the decline per year in the TFR between the two most recent surveys.

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[2] The bulk of the data in Table 1 is from the StatCompiler available at the DHS web site. In several cases, though (as indicated in the table), particularly for quite recent surveys, the data were obtained from ORC/Macro published reports because they are not yet available on the StatCompiler.

[3] That is, these four countries meet the first of the two criteria used by Bongaarts – viz., failure of the national TFR to decline between the two most recent surveys. Rwanda and Tanzania are identified in Table 1 of Bongaarts (2005) as countries experiencing fertility decline; their status has changed due to new survey data. From among these four countries, only Tanzania shows (via the DHS data) a decline of close to 10 percent in the national TFR, between 1992 and 1999. However, for each of these countries comparisons of United Nations estimates of national TFRs in the 1970s and 1980s with DHS estimates suggest that fertility decline of at least 10 percent had taken place prior to the emergence of stalling. Further, from the available DHS data it is apparent that at least in urban places, fertility had previously declined in Guinea and in Mozambique, as well as in Tanzania.

As in previous work on fertility transition in the region (Shapiro and Tambashe, 2002; Shapiro et al., 2003), we also examine data for urban and rural places separately. In our earlier studies we noted that initially fertility tended to fall primarily in urban places, while rural fertility remained stable or increased. Garenne and Joseph (2002) also emphasize the key role of urban places in the onset of fertility transition in the region. Our earlier research suggested that subsequent to the initial drop in fertility limited to urban areas, fertility declined in both urban and rural places, but typically the decline was greater in the urban milieu. And finally, in the few countries in the region in which fertility transition was relatively advanced, fertility fell as rapidly or more so in rural areas as compared to urban areas.

These observations were made prior to the emergence of stalling. Table 1 allows examination of the extent of stalling separately for urban and rural places. Among the mid-transition stalled countries (Cameroon, Ghana, Kenya), in which overall fertility is relatively low, we see increases in both rural and urban fertility most recently. That is, stalling is pervasive in these countries, regardless of place of residence. The early-transition stalled countries, by contrast, show greater variability, at least for urban places. These countries, which all have their most recent national TFRs above 5 and rural TFRs above 6, typically have reported increases recently in rural fertility, while there is no clear pattern vis-à-vis changes in urban fertility, with declines reported in two cases, an increase in another, and stability in the fourth case.

In sum, then, the data in Table 1 highlight several observations regarding fertility transition in sub-Saharan Africa, based on data at the national level from 24 countries with multiple DHS surveys. First, with the exception of only a few countries, it is evident that fertility transition has been initiated throughout the region. Second, two-thirds of the countries in which fertility decline has begun continue to experience decline, albeit with a fair degree of variability in the pace of that reduction. Third, countries in which fertility transition has stalled (the national TFR has failed to continue its previous decline) may be divided into two groups: those in which the prior fertility decline had brought the national TFR to 5 or less (mid-transition stall) and those in which the prior decline in fertility was more modest and the national TFR was approximately 5.5 to 6 (early-transition stall).

Further, disaggregation of national data into urban and rural components indicates that fertility decline tends to be stronger in urban places. Among those countries with a declining trend in fertility, it is typically the case that in comparing the two most recent surveys the magnitude of the decline is greater in urban areas than in rural areas (in only five of 14 cases does the rural decline exceed the urban decline). And countries experiencing stalling nationally, at least at the early-transition stage, in some cases still experience fertility decline in urban areas. We turn now to an examination of factors contributing to observed fertility behavior.

Factors Contributing to Fertility Decline and Fertility Stall

In this section we examine several factors that, based on both models of fertility behavior and empirical studies of fertility and fertility transition, seem likely to be pertinent to the falling and stalling of fertility. More specifically, we look at changes in these factors between the next-to-last and the most recent DHS survey in each country, and relate those changes to the corresponding changes in the national total fertility rate.

We begin with an examination of the link between changes in the educational attainment of women of reproductive age and changes in the TFR. A considerable body of research underscores the general inverse association between education and fertility (see, for example, Jejeebhoy, 1995; Rutstein, 2002), and our own prior work (Shapiro et al., 2003; Shapiro and Tambashe, 2003) emphasizes the importance of women's education as a key factor contributing to fertility decline in sub-Saharan Africa.[4] Since the secular trend is toward increased educational attainment of women (Schultz, 1993), this implies increases over time in the percentage of women with secondary or higher education and reductions in the percentage of women with no schooling. We anticipated that countries experiencing relatively large increases in the share of women with at least some secondary schooling would exhibit larger declines in fertility as compared to countries with smaller increases or with decreases in the proportion of women with secondary or higher educational attainment. By the same token, countries with relatively large declines in the percentage of women with no schooling were likewise expected to manifest larger declines in fertility.

Figure 2 shows a scatter plot for the 24 countries relating increases in the percentage of women of reproductive age with secondary or higher education to decreases in the TFR. There is clearly considerable variation across individual countries. At the same time, however, the data suggest that there is a positive relationship between the two variables (i.e., an inverse relationship between this measure of education and fertility). A simple regression of decreases in TFRs on the increases in the percentage of women with secondary or higher education yields a positive and significant coefficient (at the 5 percent level) on the education variable, implying

[4] While in general there is an inverse association between education and fertility, it is also true that some countries, particularly in sub-Saharan African, have reported higher fertility for women with some primary schooling as compared to those with no schooling. Hence, in these cases the inverse association is apparent as schooling increases only starting with primary schooling.

that a five percentage point increase in the share of better-educated women is associated with a decline in the national TFR equal to about 0.2 children. This education variable accounts for 18 percent of the variation in declines of the TFR, reflecting a correlation of 0.42.

Further evidence of the pertinence of changes in educational attainment is provided in Figure 3, which shows data relating decreases in the percentage of women with no schooling to decreases in the national TFR. As was the case in Figure 2, there is considerable variation while at the same time a generally positive relationship exists between the two variables.[5] A simple regression yields a positive coefficient on the decline in no schooling variable, which is significant at the five percent level and implies that a five percentage point drop in the percentage of women with no schooling is associated with a decline in the national TFR equal to just over 0.2 (R^2=0.16 and the correlation is just over 0.40).

Comparison of the 14 countries in which fertility has most recently been falling with the seven countries where fertility has been stalling reveals distinct differences. In the falling group, the average increase between the two most recent surveys in the percentage of women with at least some secondary schooling is 6.0 percentage points, while in the stalling group the corresponding average is 2.3 points. Likewise, for the 14 countries where fertility has been falling the average decrease in the percentage of women with no schooling is 6.3 percentage points, whereas among the seven countries in which stalling is apparent the average decrease in the percentage of women without formal education is 3.1 percentage points. On average, then, it is evident that as a group, countries in which fertility is still falling are experiencing stronger

[5] Here and in subsequent graphs, variables have been defined so as to lead us to expect a positive relationship between changes in the variable of interest and declines in fertility.

upward trends in women's educational attainment as compared to the group of countries where fertility is stalling.

A second factor pertinent to fertility behavior is mortality experience. The Easterlin framework for fertility analysis (Easterlin, 1975; Easterlin and Crimmins, 1985) views changes in mortality as a key factor influencing actual fertility, via the impact on the supply of children and ultimately on the motivation for fertility control. Indeed, observed increases in mortality in DHS surveys in West Africa during the late 1990s (Barrère et al., 1999), in the context of Easterlin's model, would be the sort of phenomenon likely to contribute to stalling of fertility transition. Overall, ten of the 24 countries that we examine have experienced increases in both the infant mortality rate (${}_1q_0$) and the infant and child mortality rate (${}_5q_0$) between consecutive DHS surveys (including all surveys, not simply the two most recent ones). This includes all three of the mid-transition stall countries and two of the four early-transition stall countries, as well as four of the 14 countries in which fertility has been declining and one of the three pre-transitional countries.

Figure 4 shows data for the two most recent surveys, relating the decline in the infant mortality rate (IMR) for the period 5-9 years prior to each survey and the decrease in the TFR.[6] There is clearly a very wide range of variation in changes in the IMR, from increases of nearly 25 per thousand to declines of more than 45 per thousand. But there is only a weak and insignificant correlation between these changes and the corresponding changes in the TFR. Somewhat stronger results may be observed in Figure 5, which focuses on lagged changes in the

[6] We initially examined the decline in the infant mortality rate for the period 0-4 years prior to each survey, but found a stronger relationship between fertility decline and the lagged mortality measure.

infant and child mortality rate (ICMR) and corresponding changes in fertility. The correlation between these two variables is 0.42, and a simple regression yields a positive and significant (at the 5% level) coefficient suggesting that a 20-point drop in the lagged ICMR ($_5q_0$) is associated with a decline of 0.15 in the total fertility rate. On average, the 14 countries most recently experiencing declining fertility had a lagged decline in the infant and child mortality rate of 19 per thousand, compared to an average lagged decline in $_5q_0$ of only 6 per thousand in the seven stalling countries.

Increased use of modern contraception is typically strongly associated with fertility decline. Figure 6 shows data from each country's two most recent surveys, linking the increase in the percentage of reproductive-age women in union using modern contraception to the observed decline in fertility. A simple regression documents that there is only a weak and statistically insignificant positive relationship between these two variables, and the simple correlation is only 0.18.

We examine growth in GDP per capita in relation to fertility decline in Figure 7, using lagged estimates of growth in GDP per capita for the period from three to eight years prior to the most recent survey[7]. This scatter plot reveals considerable variation across countries, but (contrary to our expectation) a generally negative relationship: the correlation coefficient is -.35 and a simple regression yields a weakly significant coefficient implying that a ten percentage point increase in GDP per-capita growth over the five-year period is associated with a smaller decline in the total fertility rate by not quite 0.1.

[7] Data are from the Penn World Tables (Heston et al., 2006). Since fertility is measured for the three years preceding the survey, this lag means that we are looking at the change in GDP per capita for roughly the five-year period preceding the period during which fertility is measured.

Finally, we also look at fertility preferences in relation to observed fertility. As shown in Figure 8, there is some indication of a tendency for countries experiencing larger declines in ideal family size to exhibit as well higher fertility declines. Again, however, there is considerable variation, the correlation between these two variables is 0.3, and the relationship is not significant.

To sum up, then, in this section we've examined fertility changes between the two most recent surveys in relation to changes in the educational attainment of women, infant and child mortality, modern contraceptive use, GDP per capita, and ideal family size. Changes in women's education, infant and child mortality, and, to a lesser degree, GDP per capita are significantly related to changes in fertility[8], while changes in modern contraceptive use and ideal family size are not.

We estimated a multivariate equation to account for these most recent changes in fertility, using all of the variables just considered except the infant mortality rate and ideal family size.[9] This equation is reported in Table 2, and it essentially confirms the results of the bivariate analyses. Greater increases in female educational attainment, as reflected by declines in the percentage of women of reproductive age with no schooling and increases in the percentage of these women with at least secondary education, are significantly associated with larger declines in fertility. Likewise, greater declines in the lagged infant and child mortality rate are significantly associated with more rapid fertility decline. For these variables, then, the

[8] Although, as noted above, the weakly negative association between economic growth and fertility decline ran counter to our expectation.

[9] The infant and child mortality rate is more closely linked to fertility than the infant mortality rate, while ideal family size had, in an early version of the equation in the table, a coefficient that was essentially zero.

implication is that slower socioeconomic progress contributes to the stalling of fertility transition. At the same time, however, and in contrast, more rapid (lagged) growth in GDP per capita translates into significantly slower declines in fertility, other things equal. Overall, these variables account for more than two-thirds of the variation in decline in the total fertility rate between the two most recent surveys.

Multivariate Analyses of Age-Specific Fertility Rates

In this section, we extend our analyses to examine age-specific fertility rates in urban and rural areas of the DHS countries with multiple surveys. More specifically, we analyzed the factors influencing age-specific fertility rates by estimating a series of regressions comparable to those estimated in our previous work (Shapiro et al., 2003).[10] In each case, we used data from the two most recent DHS surveys.

For each five-year age group, we regressed the age-specific fertility rates of women in urban and rural areas on variables measuring the percentage of women in the age group and corresponding place of residence who had no schooling, the percentage with secondary or higher education, the percentage in union, the percentage of women in union using modern contraception, the infant and child mortality rate (${}_5q_0$), and a dummy variable distinguishing urban from rural areas.[11] In addition, in light of the finding by Bongaarts and Watkins (1996)

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[10]These regressions were estimated for the 24 countries with multiple DHS surveys. These estimates parallel our earlier ones (Shapiro et al., 2003), but cover a larger number of countries (we analyzed data for 16 countries previously) and include more recent data, most notably data that reveals stalling.

[11] In contrast to the other variables just identified (apart from the urban dummy), the infant and child mortality rate was not calculated separately for each age group; rather, it was simply the urban or rural rate across all age groups of mothers. We did not use growth in GDP per capita in these analyses because data differentiating growth in urban from growth in rural places are not available.

and Bongaarts (2002) that as time goes by, fertility decline occurs at progressively lower levels of socioeconomic development, we also include a variable identifying a time trend.

For these analyses of age-specific fertility, it is plausible to anticipate that the error terms for different age groups may be correlated. That is, in countries where fertility of one age group is comparatively high or low, given the values of the explanatory variables, it is likely that fertility of other age groups may correspondingly be high or low as well. Correlations like this would emerge in the presence of country-specific factors whose influence cut across various age groups, and we found such correlations in our previous work. Under these circumstances, the appropriate estimation is via the method of seemingly unrelated regressions (SUR) rather than via OLS (Greene, 2000, pp. 614 ff.). Consequently, the estimates reported below are SUR estimates.

In considering the likely impacts of the explanatory variables, we anticipated that the percentage of women with no schooling, the percentage in union, and the infant and child mortality rate would all be positively related to age-specific fertility rates, while the percentage with secondary and higher education and the percentage of women in union who were using modern contraception were expected to be negatively related to fertility. The dummy variable for urban residence was expected to have a negative coefficient, reflecting the lower net benefits of children to parents in urban places. We anticipated as well that other things equal, fertility rates would be lower in later years (i.e., the expected coefficients for the time trend are negative).

In addition to these multivariate regressions, we also estimated baseline regressions in which the only explanatory variables were the urban dummy and the time trend. Our expectation here was for negative coefficients larger in absolute value than the coefficients in the multivariate equations. This hypothesis reflects the fact that the characteristics expected to be associated with lower fertility (e.g., higher levels of schooling, use of modern contraception) are typically more prevalent in urban than in rural places, and changes in these characteristics over time tend to be greater in urban areas. The mean values of the variables used in these regressions are shown in Appendix Table A-1, and indeed they show that urban women have more schooling, are considerably more likely to use modern contraception, are less likely to be in union, and experience distinctly lower infant and child mortality as compared to rural women.

The results of our analyses are reported in Table 3. For each age group, we first give the baseline regression, and then the multivariate estimate with the various explanatory variables. Consider first the baseline regressions, which show gross rural-urban fertility differences and the time trend. It is apparent that there are highly significant and substantial differences in fertility by place of residence. These (absolute) differences are largest among women aged 20-24, at almost 82 per thousand, and they are around 60 per thousand over the age range 25-39 and just slightly smaller for the youngest women (aged 15-19). The smallest absolute difference is among women aged 45-49, but since these women have the lowest overall fertility level, this is in fact the age group with the largest relative urban-rural difference (close to 40 percent). There is also a large relative difference (more than 35 percent) among women aged 40-44. The time trend variable has a significant negative coefficient in each age group except for ages 30-34, indicating declines over time in age-specific fertility rates, other things equal, ranging (for those groups with significant coefficients) from just over one point per year for the women aged 45-49 to roughly 1.5-2.2 points per year for the remaining age groups.

In these baseline regressions, the coefficients of the urban dummy variables imply that rural fertility exceeds urban fertility by 1.9 children. With an average rural TFR of 6.3 children and an average urban TFR of 4.4 children, this rural-urban difference represents over 40 percent of the urban level of fertility. The significant coefficients of the time trend variable imply that fertility declines by a bit more than 0.5 children per decade.

Once the schooling, contraception, union status, and mortality measures are added to the regressions, there is a distinct decline in the magnitude of the (absolute value of the) estimated coefficients for the urban dummy variables and the time trend variables. The declines in the coefficients of the urban dummies are more than half for the youngest women and about half for those aged 20-24, with (for the most part) progressively smaller relative declines as age increases. Taken together, the coefficients of the urban dummy variable in these latter regressions imply an urban-rural difference in the total fertility rate of just over 1.1. This net urban-rural difference in fertility represents 58 percent of the corresponding gross difference. To put the matter a bit differently, controlling for schooling, use of modern contraception, the percentage of women in union, and infant and child mortality allows us to account for 42 percent of the observed urban-rural difference in fertility, net of the time trend. Likewise, the coefficients of the time trend in the full equations have also declined in absolute value, and also in significance. These coefficients imply that net of the factors included in the equations, fertility declines by not quite 0.2 children per decade (again, only significant coefficients are considered for this calculation). Hence, controlling for these additional factors accounts for about 70 percent of the observed gross fertility difference over time.

The substantive results of the multivariate analyses indicate that the prevalence of modern contraception is significantly negatively related to fertility among women aged 25-44. The percentage of women in union is highly significantly positively related to fertility of urban and rural women for the three youngest age groups, with diminishing impact in moving from younger to older groups. Infant and child mortality is significantly positively related to fertility of women aged 20-34. Among the oldest women (aged 45-49), apart from the significant positive coefficient for the percentage with no schooling, none of the explanatory variables other than the urban dummy and the time trend is significantly related to age-specific fertility rates.

The very limited significant effects of women's educational attainment on fertility at first glance seems somewhat surprising. However, the equations reported in Table 3 include two proximate determinants of fertility, use of modern contraception and the percentage in union, that are themselves influenced by women's educational attainment. Further, there is a large body of literature suggesting that increased women's schooling contributes to lower infant and child mortality. By including in Table 3 these variables that are themselves influenced by education, we may have thereby given a misleading (and downward-biased) view of the importance of education for fertility transition in the region.[12]

To assess this argument, then, we have estimated equations showing the relationship between women's educational attainment and all three of the other explanatory variables (apart from the urban dummy variable and the time trend) in Table 3. That is, we regressed the prevalence of modern contraception, the percentage of women in union, and the infant and child mortality rate on the two dummy variables for educational attainment, and we also included the

[12] We are grateful to Paul Schultz for drawing our attention to this point.

urban dummy variable and the time trend as explanatory variables in these equations. As in Table 3, we used the method of seemingly unrelated regressions. The results of this estimation are provided in Table 4.

The influence of women's educational attainment on each of these three variables is evident, albeit to varying degrees. Higher percentages of women with no schooling result in lower contraceptive use, greater marriage rates, and to a limited degree higher levels of infant and child mortality. Conversely, greater percentages of women with secondary or higher education are clearly associated with greater contraceptive use and, to a lesser degree, with lower percentages in union among women aged 15-34, but there is no strong evidence of lower infant and child mortality rates.[13] Overall, though, it is evident that education influences these three variables: other things equal, a better-educated population of women of reproductive age is associated with greater use of modern contraception, lower rates of women in union, and lower infant and child mortality.

Urban residence is significantly associated with greater use of modern contraception, lower percentages of women who are married, and substantially lower infant and child mortality rates, net of education. Virtually the only statistically significant time trends indicate that, net of education, infant and child mortality declines over time.

The final step in these multivariate analyses, then, is given by Table 5, which provides reduced-form estimates that more clearly emphasize the importance of educational attainment, or perhaps more accurately, the importance of exposure to schooling, for fertility and fertility

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[13] The fact that infant and child mortality rates are not measured separately for the different age groups undoubtedly contributes to the comparatively weak performance of the two schooling variables in accounting for differences in infant and child mortality.

transition in sub-Saharan Africa. These equations omit contraceptive prevalence, percentage married, and infant and child mortality, and simply examine age-specific fertility rates as a function of educational attainment, urban residence, and the time trend. The coefficients on the first educational attainment variable indicate that higher percentages of women with no schooling are typically associated with significantly greater age-specific fertility rates. Higher percentages of women with secondary or higher education are consistently associated with lower fertility rates, but the differences are not statistically significant. As before, urban-rural fertility differences, other things equal, are substantial and highly significant and the coefficients of the time trend variables are all negative and, with one exception, significant.

In addition to the equations just reported, which are based on data from the two most recent surveys in each country, we have also estimated comparable equations using data from the first and last survey in each country. These latter estimates, which are provided as Appendix Tables A-2, A-3, and A-4, cover a distinctly longer time period, during which changes in variables are greater than when the two most recent surveys are used. They thus provide a complementary perspective on the ongoing fertility transition in sub-Saharan Africa.

In brief, the appendix tables show generally similar results to those reported above. One notable exception to this statement, however, is that there are significant relationships in the appendix tables between age-specific fertility rates and the percentage of women with secondary or higher education. This is the case both for the full model and the reduced-form equations. In addition, the equations based on the longer time frame reveal generally significant time trends with respect to use of modern contraception. In short, then, analysis of data for the longer period from first to last survey reinforces our finding that increased educational attainment of women has played a key role in fertility transition in the region.

Discussion and Conclusions

Using data for countries with multiple DHS surveys, we have examined fertility behavior in two dozen countries in sub-Saharan Africa, representing about three-quarters of the population of the region. All but a few of these countries have experienced the onset of fertility transition, and in two-thirds of the countries in which transition has begun the most recent DHS surveys suggest that fertility decline is still under way. However, the pace of decline is slow in several of these countries, and stalling of fertility decline is evident in the remaining third of countries where fertility decline had begun, with some of the stalling countries being in mid-transition while others are still in an early stage of fertility transition.

Examination of national-level changes in fertility in relation to changes in variables presumed to be related to fertility levels and changes found significant associations for two schooling variables, the lagged infant and child mortality rate (${}_5q_0$), and for lagged growth in GDP per capita. The first two of these findings suggest, as Bongaarts (2005) has postulated, that stalling of fertility decline may reflect faltering in the pace of socioeconomic development. At the same time, the results indicating that higher growth in GDP per capita was associated with smaller declines in fertility run counter to this notion. Further, we did not find evidence of any significant relationships between changes in fertility on the one hand and changes in modern contraceptive use or ideal fertility on the other hand.

Disaggregation of national-level data to urban and rural components reveals additional differences, with fertility transition typically being distinctly stronger in urban areas. Our multivariate analyses of age-specific fertility rates document that education, infant and child mortality, modern contraceptive use, the percentage of women in union, place of residence, and time all are significantly related to fertility levels, and hence presumably influence changes in fertility as well. We put particular emphasis on increasing education as a key factor in promoting fertility decline, in large part because of its association with marriage, contraceptive use, and infant and child mortality.

What is the future of fertility transition in the region? Our data analyses suggest that in part, the answer will depend on the future of changes in education and in infant and child mortality. If the longer-term improvements in these socioeconomic indicators that have been realized in the past do not continue throughout the region (i.e., with stagnation or backsliding), then the stalling phenomenon may well spread to additional countries. Conversely, stronger progress in increasing women's education and reducing infant and child mortality in the future would be expected to enhance the likelihood of resumption of fertility decline in the stalling countries.

But even with resumption of fertility decline, however, the questions remains, how far might fertility fall? As Bongaarts (2002) has noted, it is not at all apparent that assuming that fertility will fall to the replacement level (as in United Nations fertility projections) is the appropriate assumption. Indeed, in what may well have been a very prescient observation, Lesthaeghe (1989b) almost 20 years ago raised the possibility that fertility decline in sub-Saharan Africa might stall at high levels (4-5 children), reflecting the old-age security function of children. This raises the possibility that even sustained or resumed socioeconomic development, in the absence of alternative mechanisms for old-age security, would not be sufficient to prevent stalling on a wider basis.

References

Barrère, Bernard, Goram Mboup, and Mohammed Ayad. 1999. *Enquêtes Démographiques et de Santé en Afrique de l'Ouest: résultats des Enquêtes Démographiques et de Santé réalisées au Burkina Faso (1998-99), au Cameroun (1998), en Côte d'Ivoire (1998-99) et au Togo (1998)*. Calverton, Maryland, Macro International Inc.

Bongaarts, John. 2002. "The End of the Fertility Transition in the Developing World." Working Paper No. 161. New York: The Population Council.

Bongaarts, John. 2005. "The Causes of Stalling Fertility Transitions." Paper presented at the IUSSP International Population Conference, Tours, France, July 2005.

Bongaarts, John, and Susan Cotts Watkins. 1996. "Social Interactions and Contemporary Fertility Transitions." *Population and Development Review*, Vo. 22, No. 4, pp. 639-682.

Cohen, Barney. 1998. "The Emerging Fertility Transition in Sub-Saharan Africa." *World Development*, Vol. 26, No. 8, pp. 1431-1461.

Easterlin, Richard A. 1975. "An Economic Framework for Fertility Analysis." *Studies in Family Planning*, Vol. 6, pp. 54-63.

Easterlin, Richard A. and Eileen M. Crimmins. 1985. *The Fertility Revolution: A Supply-Demand Analysis*. Chicago: University of Chicago Press.

Greene, William H. 2000. *Econometric Analysis, 4th Edition*. Upper Saddle River, NJ: Prentice Hall.

Garenne, Michel and Veronique Joseph. 2002. "The Timing of the Fertility Transition in Sub-Saharan Africa." *World Development*, Vol. 30, No. 10, pp. 1835-1843.

Heston, Alan, Robert Summers, and Bettina Aten. 2006. *Penn World Table Version 6.2.* Center for International Comparisons of Production, Income and Prices, University of Pennsylvania.

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

Lesthaeghe, Ron J. 1989a. (ed.) *Reproduction and Social Organization in Sub-Saharan Africa*. Berkeley and Los Angeles: University of California Press.

Lesthaeghe, Ron J. 1989b. "Social Organization, Economic Crisis, and the Future of Fertility Control in Africa." In Ron J. Lesthaeghe, ed., *Reproduction and Social Organization in Sub-Saharan Africa*, pp. 475-505. Berkeley and Los Angeles: University of California Press.

Rutstein, Shea O. 2002. *Fertility Levels, Trends, and Differentials 1995-1999*. DHS Comparative Reports No. 3. Calverton, Maryland: ORC Macro.

Schultz, T. Paul. 1993. "Investments in the Schooling and Health of Women and Men: Quantities and Returns." *Journal of Human Resources*, Vol. 28, No. 4, pp. 694-734.

Shapiro, David and B. Oleko Tambashe. 2002. "Fertility Transition in Urban and Rural Sub-Saharan Africa: Preliminary Evidence of a Three-Stage Process." *Journal of African Policy Studies*, Vol. 8, No. 2&3, pp. 103-127.

Shapiro, David with B. Oleko Tambashe. 2003. *Kinshasa in Transition: Women's Education, Employment, and Fertility.* Chicago: University of Chicago Press.

Shapiro, David, Tesfayi Gebreselassie, and Lisa Strunk. 2003. "Fertility Transition in Sub-Saharan Africa: Evidence from the Demographic and Health Surveys." Paper presented at the Annual Meeting of the Population Association of America, Minneapolis, May 2003.

Tabutin, Dominique. 1997. "Les transitions démographiques en Afrique sub-Saharienne: Spécificités, changements... et incertitudes." In International Union for the Scientific Study of Population, *International Population Conference, Beijing 1997, Vol. 1*, pp. 219-247. Liège, Belgium: International Union for the Scientific Study of Population.

Tabutin, Dominique and Bruno Schoumaker. 2001. "Une analyse régionale des transitions de fécondité en Afrique sub-Saharienne." Paper presented at the General Congress of the International Union for the Scientific Study of Population, Salvador, Brazil. Louvain-la-Neuve, Belgium: Institut de Démographie, Université Catholique de Louvain.

Westoff, Charles F. and Anne R. Cross. 2005. "The Stall in the Fertility Transition in Kenya." Paper presented at the IUSSP International Population Conference, Tours, France, July 2005.

Table 1. Estimated Total Fertility Rates, National and by Rural and Urban Residence, and Trend: Countries with Multiple Surveys

Country (year of survey)	TFR			Trend
	National	Rural	Urban	
Benin (1996)	6.0	6.7	4.9	
Benin (2001)	5.6	6.4	4.4	decline
Burkina Faso (1992/93)	6.5	7.0	4.6	
Burkina Faso (1998/99)	6.4	6.9	3.9	
Burkina Faso (2003)	5.9	6.5	3.4	decline
Cameroon (1991)	5.8	6.3	5.2	
Cameroon (1998)	4.8	5.4	3.8	
Cameroon (2004)	5.0	6.1	4.0	mid-transition stall
Chad (1996/97)	6.4	6.5	5.9	
Chad (2004)	6.3	6.5	5.7	decline
Cote d'Ivoire (1994)	5.3	6.0	4.4	
Cote d'Ivoire (1998/99)	5.2	6.0	4.0	decline
Eritrea (1995)	6.1	7.0	4.2	
Eritrea (2002)	4.8	5.7	3.5	decline
Ethiopia (2000)	5.5	6.0	3.0	
Ethiopia (2005)*	5.4	6.0	2.4	decline
Ghana (1988)	6.4	7.0	5.3	
Ghana (1993)	5.2	6.0	3.7	
Ghana (1998)	4.4	5.3	3.0	
Ghana (2003)	4.4	5.6	3.1	mid-transition stall
Guinea (1992)*	5.7	5.9	5.2	
Guinea (1999)	5.5	6.1	4.4	
Guinea (2005)*	5.7	6.3	4.4	early-transition stall
Kenya (1989)	6.7	7.1	4.5	
Kenya (1993)	5.4	5.8	3.4	
Kenya (1998)	4.7	5.2	3.1	
Kenya (2003)	4.9	5.4	3.3	mid-transition stall
Madagascar (1992)	6.1	6.7	3.8	
Madagascar (1997)	6.0	6.7	4.2	
Madagascar (2003/04)	5.2	5.7	3.7	decline
Malawi (1992)	6.7	6.9	5.5	
Malawi (2000)	6.3	6.7	4.5	
Malawi (2004)*	6.0	6.4	4.2	decline
Mali (1987)	7.1	7.4	6.3	
Mali (1995/96)	6.7	7.3	5.4	
Mali (2001)	6.8	7.3	5.5	pre-transition
Mozambique (1997)	5.2	5.3	4.6	
Mozambique (2003)	5.5	6.1	4.4	early-transition stall

Country (year of survey)	TFR			Trend
	National	Rural	Urban	
Namibia (1992)	5.4	6.3	4.0	
Namibia (2000)	4.2	5.1	3.1	decline
Niger (1992)	7.0	7.1	6.4	
Niger (1998)	7.2	7.6	5.6	
Niger (2006)+	7.1	7.4	6.0	pre-transition
Nigeria (1990)	6.0	6.3	5.0	
Nigeria (2003)	5.7	6.1	4.9	decline
Rwanda (1992)	6.2	6.3	4.5	
Rwanda (2000)	5.8	5.9	5.2	
Rwanda (2005)*	6.1	6.3	4.9	early-transition stall
Senegal (1986)	6.4	7.1	5.4	
Senegal (1992/93)	6.0	6.7	5.1	
Senegal (1997)	5.7	6.7	4.3	
Senegal (2005)*	5.3	6.4	4.1	decline
Tanzania (1992)	6.2	6.6	5.1	
Tanzania (1996)	5.8	6.3	4.1	
Tanzania (1999)	5.6	6.5	3.2	
Tanzania (2004)	5.7	6.5	3.6	early-transition stall
Togo (1988)	6.4	7.3	4.9	
Togo (1998)	5.2	6.3	3.2	decline
Uganda (1988)	7.4	7.6	5.7	
Uganda (1995)	6.9	7.2	5.0	
Uganda (2000/01)	6.9	7.4	4.0	pre-transition
Zambia (1992)	6.5	7.1	5.8	
Zambia (1996)	6.1	6.9	5.1	
Zambia (2001/02)	5.9	6.9	4.3	decline
Zimbabwe (1988/89)	5.4	6.2	3.8	
Zimbabwe (1994)	4.3	4.9	3.1	
Zimbabwe (1999)	4.0	4.6	3.0	
Zimbabwe (2005/06)+	3.8	4.6	2.6	decline

Except as noted, data are from ORC Macro's online StatCompiler, and provide TFRs based on the three years preceding each survey.

Notes: + Estimates obtained from DHS Preliminary Report. For Niger the reference period is the five years preceding the survey; a comparable reference period in 1998 yielded a national TFR of 7.5, implying that fertility fell by more than indicated in the table.

* Estimates obtained from DHS Final Report or directly from ORC/Macro.

Table 2. Regression Analysis of the Decline in the Total Fertility Rate Between the Two Most Recent Surveys

Variable	Coefficient
Decline in percentage of women with no schooling	.031+
Increase in percentage of women with at least secondary education	.043*
Growth in the percentage of women using modern contraception	-.023
Decline in the infant and child mortality rate (5-year lag)	.010**
Percentage growth in GDP per capita over 5 years (3-year lag)	-.011**
Intercept	.058
R^2	.685
$\overline{R}^2$	.597
F-Ratio	7.81**
n	24

** Significant at the .01 level.
* Significant at the .05 level.
$^+$ Significant at the .10 level.

Table 3. Multivariate Analyses of Age-Specific Fertility Rates

Age Group	Urban	Schooling: None	Schooling: Secondary +	Modern Contraception	In Union	${}_5q_0$	Time Trend	Intercept	$\overline{R}^2$
15-19	-56.92**						-2.24*	183.80**	0.348
	-23.79**	-0.11	0.06	1.24**	2.39**	0.12	-1.33*	68.75**	0.735
20-24	-81.98**						-2.20*	306.31**	0.506
	-41.75**	-0.28*	0.01	-0.07	1.69**	0.26**	-1.22	137.42**	0.706
25-29	-63.73**						-2.05*	297.72**	0.440
	-38.76**	-0.16	0.23	-0.88**	0.83**	0.32**	-1.11	174.21**	0.636
30-34	-60.58**						-1.17	254.40**	0.329
	-35.18**	0.16	0.19	-1.27**	-0.01	0.22*	-0.14	207.12**	0.515
35-39	-58.27**						-1.71*	200.48**	0.448
	-37.20**	0.26*	0.02	-0.68**	0.43	0.07	-1.00	134.08**	0.576
40-44	-40.69**						-1.48**	112.20**	0.481
	-29.83**	0.09	-0.08	-0.71**	-0.33	0.03	-1.08*	131.39**	0.605
45-49	-18.29**						-1.04**	47.02**	0.317
	-15.87**	0.25**	-0.03	0.04	-0.10	-0.05	-0.86*	43.54**	0.388

** Significant at the .01 level.
* Significant at the .05 level.
+ Significant at the .10 level.
Sample size = 96. Estimates from SUR model.

Table 4. Educational Attainment and Contraception, Marriage, and Mortality

a. Percentage using modern contraceptives

Age group	Urban	Percentage with no education	Percentage with Secondary+	Time Trend	Intercept	$\overline{R}^2$
15 – 19	3.14**	-0.01	0.03	0.16	1.43	0.238
20 – 24	5.19**	-0.07**	0.08**	0.35+	6.66*	0.408
25 – 29	5.55**	-0.07**	0.16**	0.35	8.54*	0.461
30 – 34	5.57**	-0.08**	0.18**	0.33	9.62**	0.460
35 – 39	6.70**	-0.11**	0.13**	0.27	13.49**	0.448
40 – 44	6.24**	-0.10**	0.12**	0.19	13.37**	0.448
45 – 49	2.98*	-0.07**	0.13**	0.10	9.92**	0.417

b. Percentage in union

Age group	Urban	Percentage with no education	Percentage with Secondary+	Time Trend	Intercept	$\overline{R}^2$
15 – 19	-8.10**	0.21**	-0.10+	-0.27	30.64**	0.500
20 – 24	-14.23**	0.15**	-0.09*	-0.31	72.87**	0.518
25 – 29	-5.83**	0.10**	-0.11*	-0.10	82.40**	0.462
30 – 34	-3.75*	0.09**	-0.06+	-0.11	83.89**	0.455
35 – 39	-3.87*	0.12**	0.00	-0.14	80.85**	0.379
40 – 44	-5.62**	0.12**	0.07	-0.16	77.82**	0.333
45 – 49	-6.97**	0.09**	0.04	-0.31	77.14**	0.285

c. Infant and Child Mortality[1]

Age group	Urban	Percentage with no education	Percentage with Secondary+	Time Trend	Intercept	$\overline{R}^2$
15 – 19	-40.67**	0.21**	-0.12+	-1.56+	187.96**	0.337
20 – 24	-42.73**	0.14*	-0.07	-1.66+	190.42**	0.300
25 – 29	-42.46**	0.10	-0.11	-1.63+	191.26**	0.296
30 – 34	-43.75**	0.09+	-0.09	-1.59+	190.95**	0.280
35 – 39	-45.18**	0.10	-0.03	-1.61+	189.55**	0.268
40 – 44	-45.29**	0.09	-0.05	-1.58	189.70**	0.263
45 – 49	-45.05**	0.11	-0.06	-1.54	187.21**	0.273

** Significant at the .01 level.
* Significant at the .05 level.
+ Significant at the .10 level.
Sample size = 96. Estimates from SUR model.

[1] Mortality is not measured separately by age group, but simply separately by place of residence.

Table 5. Reduced-Form Estimates of the Impact of Education, Urban Residence, and Time on Age-Specific Fertility Rates

Age group	Urban	Proportion with no education	Proportion with Secondary+	Time Trend	Intercept	$\overline{R}^2$
15 – 19	-41.08**	0.55**	-0.13	-1.89*	159.08**	0.441
20 – 24	-70.07**	0.24	-0.20	-2.10*	296.57**	0.551
25 – 29	-52.83**	0.22+	-0.18	-1.88*	286.12**	0.507
30 – 34	-47.56**	0.34*	-0.15	-0.80	232.44**	0.420
35 – 39	-47.14**	0.39**	-0.06	-1.37+	173.81**	0.538
40 – 44	-35.05**	0.11	-0.14	-1.26*	103.29**	0.527
45 – 49	-15.16**	0.14*	-0.01	-0.87*	35.28**	0.374

** Significant at the .01 level.
* Significant at the .05 level.
+ Significant at the .10 level.

Sample size = 96. Estimates from SUR model.

Table A-1. Mean Values of the Variables Used in the Multivariate Analyses of Age-Specific Fertility Rates

Age Group	Schooling		Modern Contraception	In Union	Age-Specific Fertility Rate
	None	Secondary+			
Urban					
15-19	18	41	8	19	100
20-24	22	44	18	54	198
25-29	26	40	23	74	209
30-34	29	36	23	80	180
35-39	34	30	24	80	122
40-44	40	27	21	77	54
45-49	48	20	13	72	16
Rural					
15-19	41	16	4	34	157
20-24	49	17	9	775	280
25-29	54	12	11	85	273
30-34	55	10	11	87	240
35-39	60	8	11	86	180
40-44	64	6	10	84	94
45-49	69	4	7	80	34

The mean of infant and child mortality rates per 1000 (${}_5q_0$) for urban is 127, and the mean of (${}_5q_0$) for rural is 176.

Table A-2. Multivariate Analyses of Age-Specific Fertility Rates (First and Last Surveys)

Age Group	Urban	Schooling		Modern Contraception	In Union	${}_5q_0$	Time Trend	Intercept	$\overline{R}^2$
		None	Secondary +						
15-19	-54.44**						-1.32+	170.83**	0.331
	-21.81**	-0.23	0.09	1.49**	2.10**	0.26**	-.76+	46.74**	0.777
20-24	-75.19**						-2.33**	304.79**	0.488
	-35.66**	-0.53**	-0.36*	0.29	1.59**	0.29**	-1.33*	151.90**	0.737
25-29	-58.96**						-2.48**	301.88**	0.464
	-32.57**	-0.18	-0.17	-0.53*	0.79**	0.25**	-1.67**	198.98**	0.641
30-34	-61.81**						-1.84**	264.58**	0.470
	-29.50**	0.01	-0.59**	-0.46*	0.62*	0.16*	-1.02*	183.40**	0.682
35-39	-56.46**						-1.97**	205.66**	0.490
	-35.91**	0.19	-0.28	-0.40	0.17	0.08	-1.46**	164.71**	0.594
40-44	-38.83**						-1.63**	114.01**	0.507
	-27.68**	0.15	-0.36+	-0.33	-0.33	0.00	-1.19**	131.39**	0.599
45-49	-19.69**						-0.74**	44.99**	0.348
	-19.24**	0.30**	0.20	0.17	-0.09	-0.03	-0.73**	33.47*	0.395

** Significant at the .01 level.
*   Significant at the .05 level.
\+ Significant at the .10 level.

Sample size = 96. Estimates from SUR model.

Table A-3. Educational Attainment and Contraception, Marriage, and Mortality (First and Last Surveys)

a. Percentage using modern contraceptives

Age group	Urban	Percentage with no schooling	Percentage with secondary+	Time trend	Intercept	$\overline{R}^2$
15 – 19	2.28*	-0.03	0.01	0.27**	1.49	0.253
20 – 24	2.93+	-0.09**	0.09**	0.46**	6.51**	0.448
25 – 29	2.80	-0.11**	0.18**	0.40*	9.78**	0.482
30 – 34	3.78+	-0.16**	0.12**	0.31+	15.68**	0.518
35 – 39	3.47+	-0.14**	0.22**	0.25	15.29**	0.544
40 – 44	3.78*	-0.15**	0.15**	0.17	17.02**	0.557
45 – 49	1.94	-0.12**	0.12*	0.06	14.31**	0.530

b. Percentage in union

Age group	Urban	Percentage with no schooling	Percentage with secondary+	Time trend	Intercept	$\overline{R}^2$
15 – 19	-5.73*	0.27**	-0.14*	-0.24	28.49**	0.554
20 – 24	-8.96**	0.22**	-0.18**	-0.33	69.96**	0.590
25 – 29	-3.86*	0.17**	-0.11*	-0.17	79.61**	0.551
30 – 34	-2.37	0.17**	-0.03	-0.06	78.14**	0.559
35 – 39	-2.78+	0.19**	0.05	-0.15	76.31**	0.461
40 – 44	-4.86**	0.22**	0.16**	-0.06	68.88**	0.414
45 – 49	-8.31**	0.21**	0.32**	-0.32*	67.80**	0.393

c. Infant and Child Mortality[1]

Age group	Urban	Percentage with no schooling	Percentage with secondary+	Time trend	Intercept	$\overline{R}^2$
15 – 19	-40.73**	0.27**	-0.11	-1.32*	183.16**	0.389
20 – 24	-43.29**	0.19**	-0.06	-1.38*	184.85**	0.346
25 – 29	-44.97**	0.15*	-0.03	-1.35*	185.36**	0.320
30 – 34	-45.06**	0.15*	-0.04	-1.31*	184.57**	0.318
35 – 39	-46.13**	0.14*	-0.02	-1.33*	184.46**	0.306
40 – 44	-46.43**	0.15*	0.00	-1.28+	182.24**	0.302
45 – 49	-46.58**	0.17*	0.02	-1.25+	179.57**	0.312

** Significant at the .01 level.
* Significant at the .05 level.
+ Significant at the .10 level.

Sample size = 96. Estimates from SUR model.

[1] Mortality is not measured separately by age group, but simply separately by place of residence.

Table A-4. Reduced-Form Estimates of the Impact of Education, Urban Residence, and Time on Age-Specific Fertility Rates (First and Last Surveys)

Age group	Urban	Percentage with no schooling	Percentage with secondary+	Time trend	Intercept	$\overline{R}^2$
15 – 19	-32.47**	0.57**	-0.37	-1.12+	149.95**	0.464
20 – 24	-51.80**	0.01	-0.83**	-2.09**	313.69**	0.579
25 – 29	-40.26**	0.22	-0.50**	-2.29**	294.06**	0.561
30 – 34	-35.05**	0.31*	-0.77**	-1.33**	248.27**	0.652
35 – 39	-40.78**	0.32*	-0.36	-1.68**	184.97**	0.574
40 – 44	-28.37**	0.08	-0.48**	-1.25**	107.00**	0.581
45 – 49	-18.38**	0.20**	0.23	-0.71**	28.81**	0.389

** Significant at the .01 level.
* Significant at the .05 level.
+ Significant at the .10 level.

Sample size = 96. Estimates from SUR model.

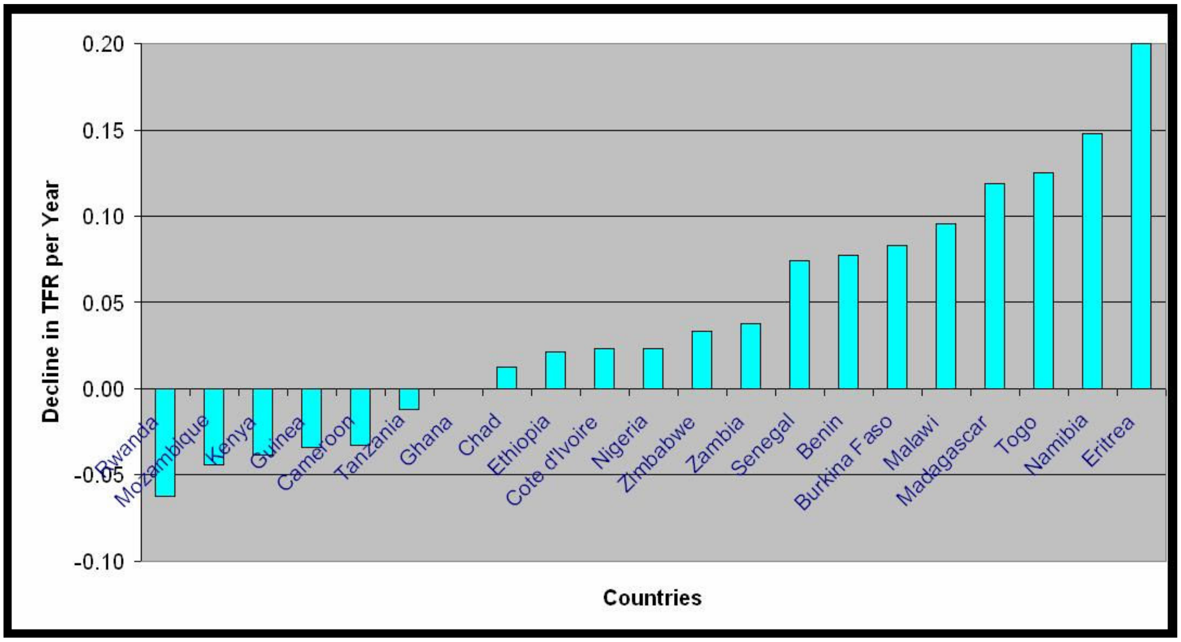

Fig. 1: Decline in TFR per Year, Stalling and Declining Countries

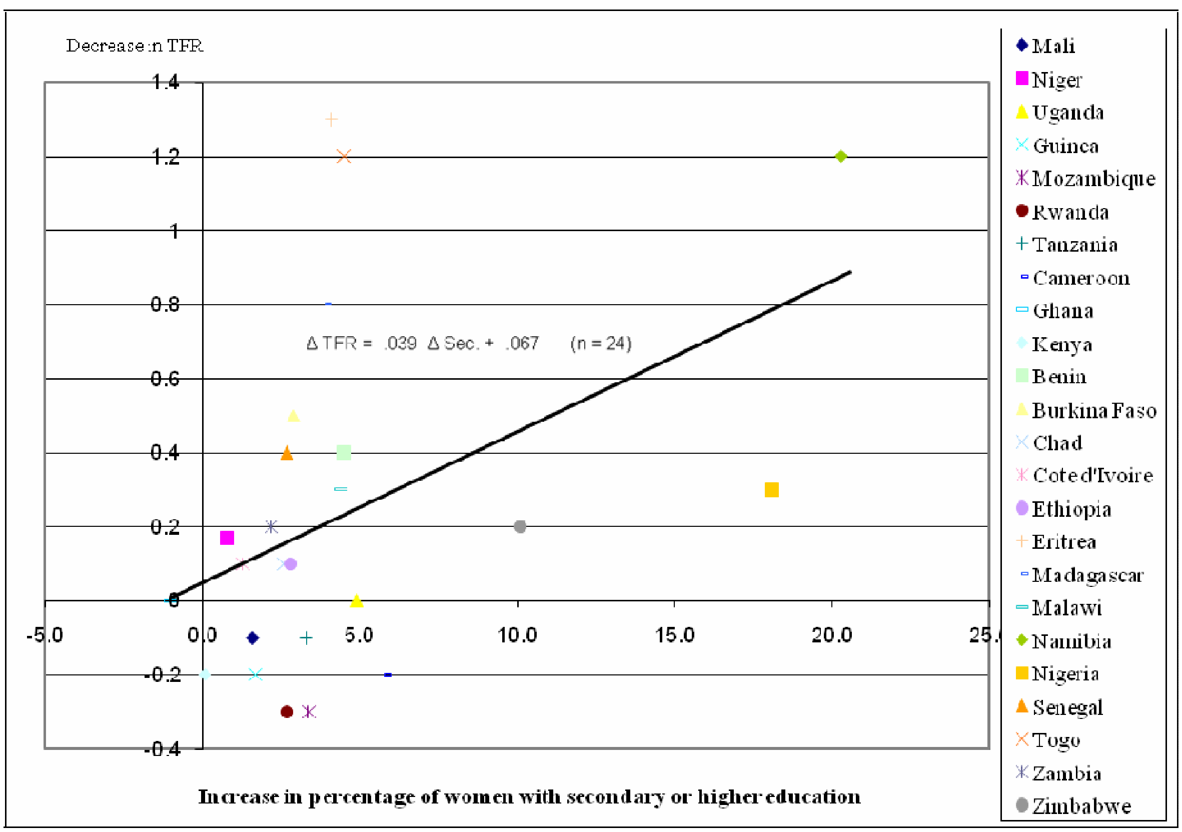

Fig. 2: Increase in the Percentage of Women with Secondary or Higher Education and Decrease in Fertility

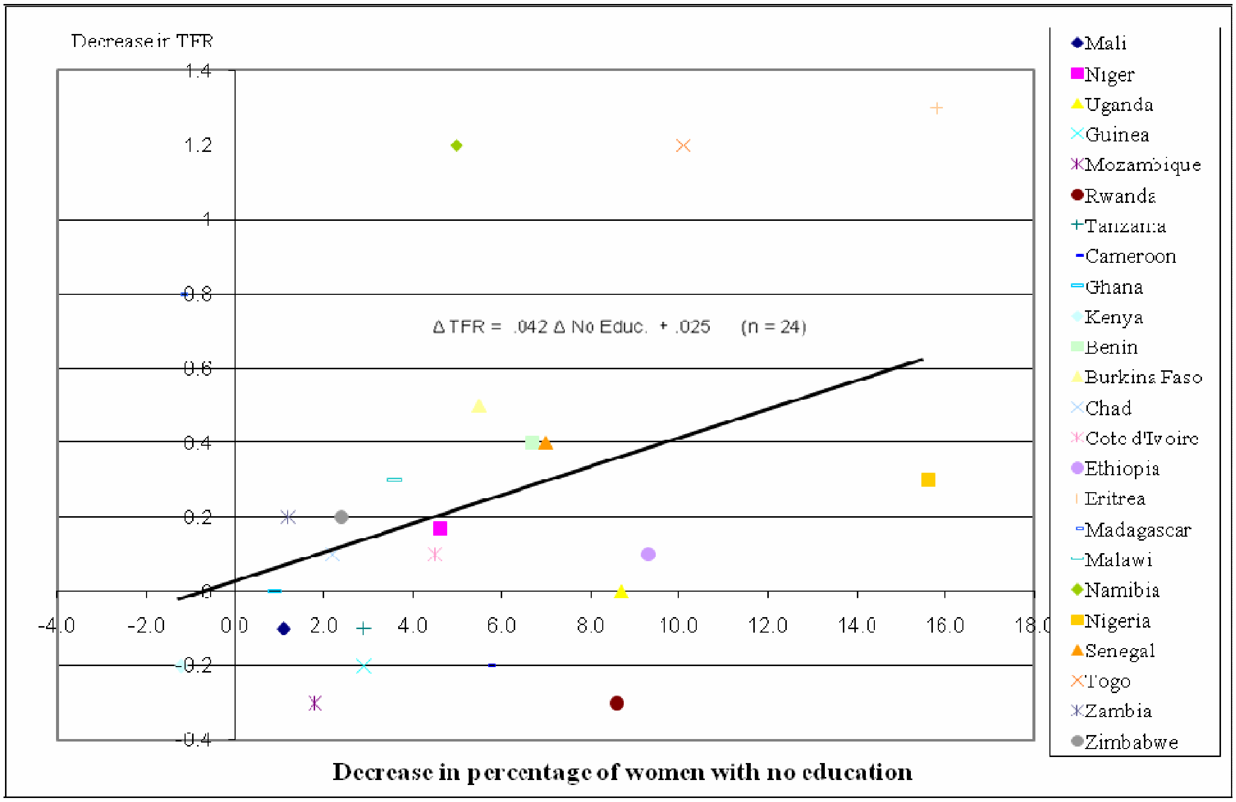

Fig. 3: Decrease in the Percentage of Women with No Schooling and Decrease in Fertility

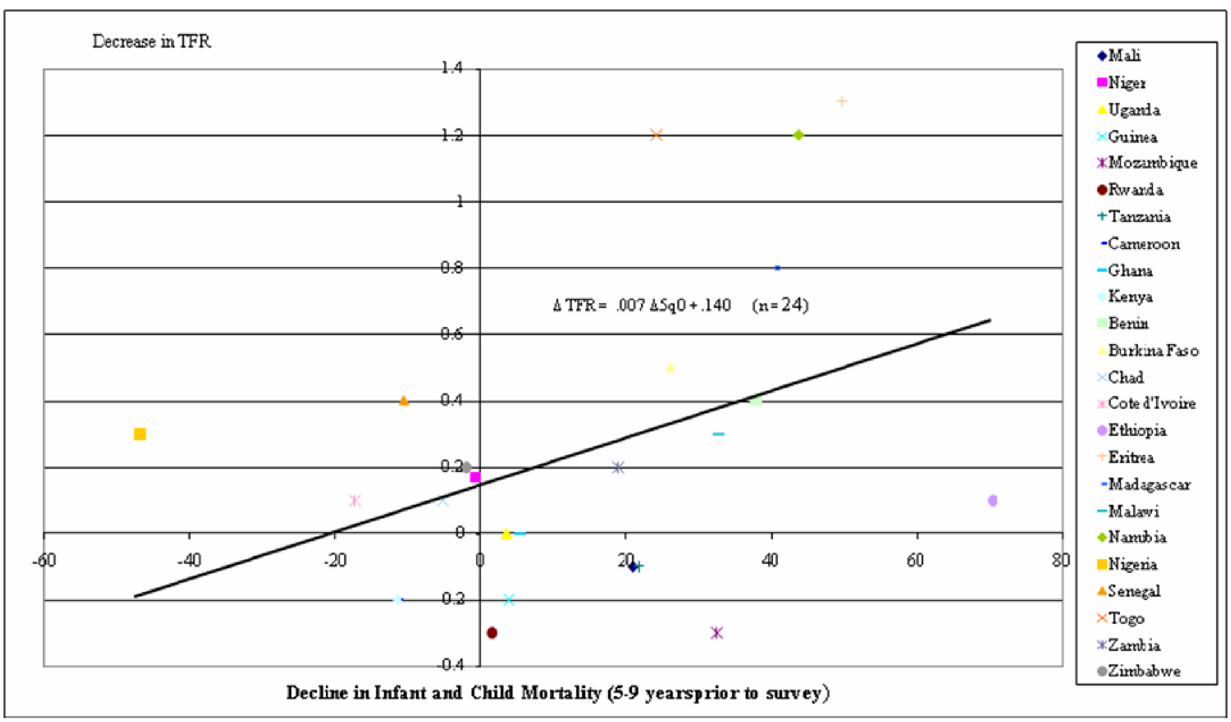

Fig. 4: Decline in Infant Mortality and Decrease in Fertility

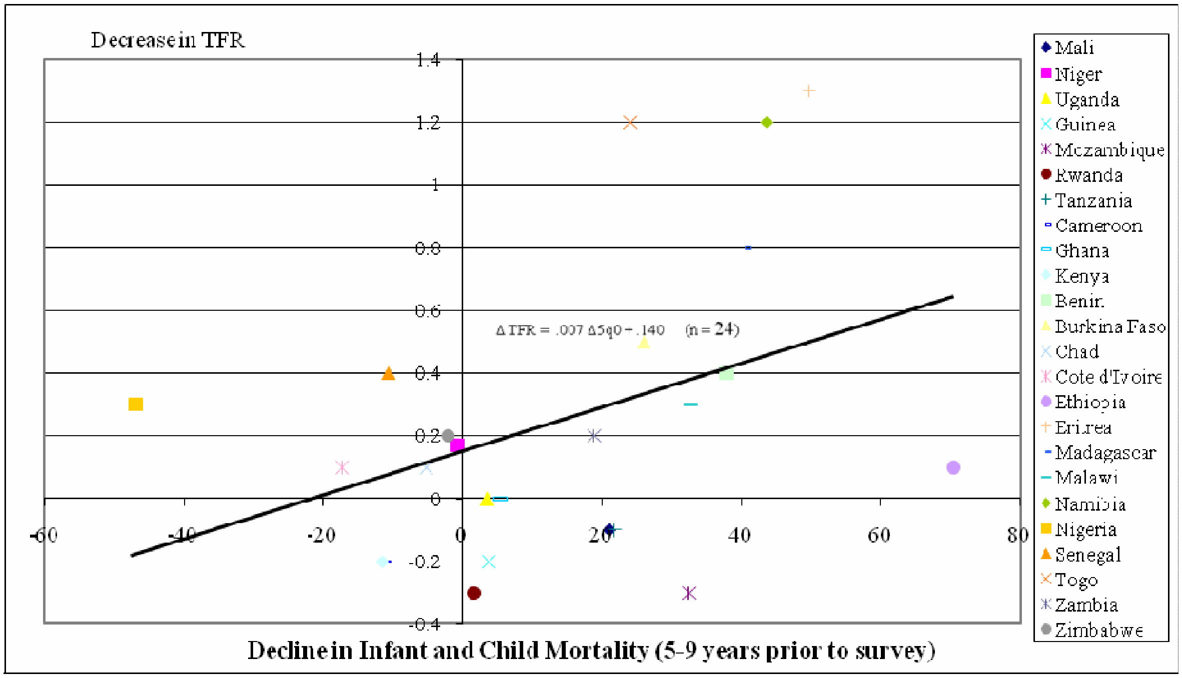

Fig. 5: Decline in Infant and Child Mortality and Decrease in Fertility

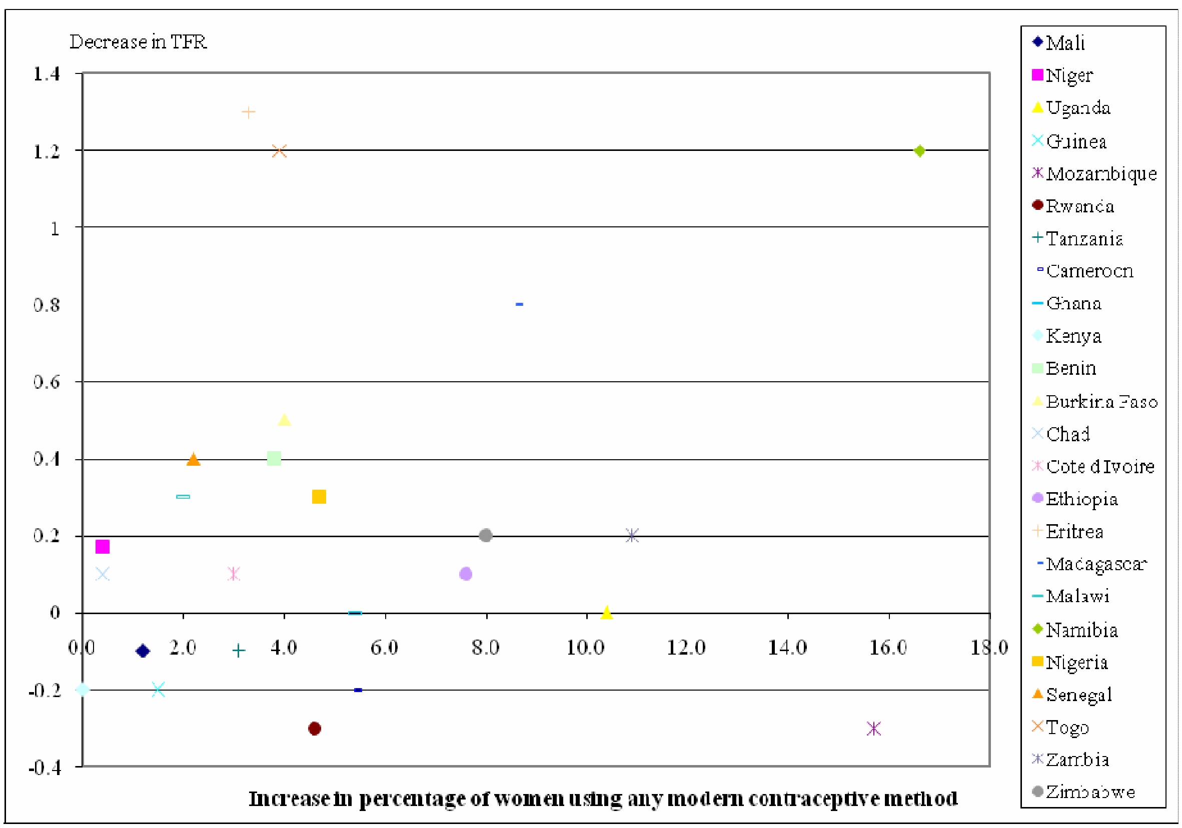

Fig. 6: Increase in the Percentage of Women using Any Modern Contraceptive Method and Decrease in Fertility

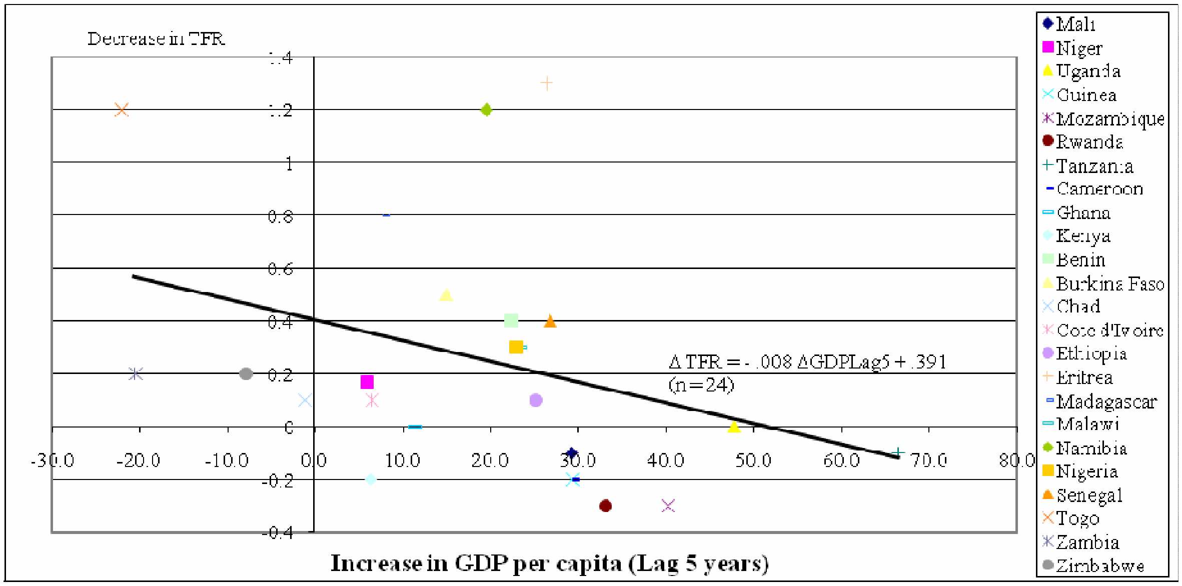

Fig. 7: Growth Rate of GDP per capita and Decrease in Fertility

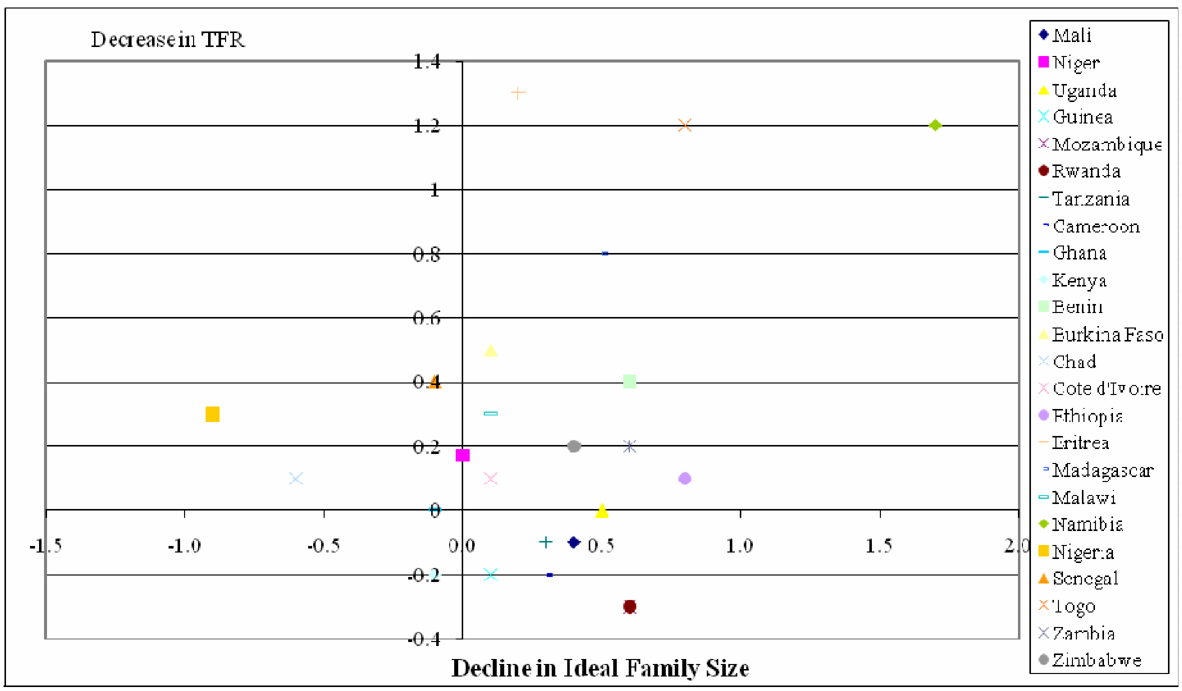

Fig. 8: Decline in Ideal Family Size and Decrease in Fertility