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FERTILITY CHANGES IN SUB-SAHARAN AFRICA

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- To provide decisionmakers in survey countries with information useful for informed policy choices;
- To expand the international population and health database;
- To advance survey methodology; and
- To develop in participating countries the skills and resources necessary to conduct high-quality demographic and health surveys.

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Fertility Changes in Sub-Saharan Africa

M. Michel Garenne
French Institute of Research for Development (IRD)
Institut Pasteur, Paris

Macro International Inc.
Calverton, Maryland, USA

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Author address: M. Michel Garenne, Institut Pasteur, Epidémiologie des Maladies Emergentes, 25 rue du Docteur Roux, 75724 Paris Cedex 15, France. Email: mgarenne@pasteur.fr.

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Contents

Tables and Figures

Preface

One of the most significant contributions of the MEASURE DHS program is the creation of an internationally comparable body of data on the demographic and health characteristics of populations in developing countries. The *DHS Comparative Reports* series examines these data across countries in a comparative framework. The *DHS Analytical Studies* series focuses on specific topics. The principal objectives of both series are to provide information for policy formulation at the international level and to examine individual country results in an international context. Whereas *Comparative Reports* are primarily descriptive, *Analytical Studies* have a more analytical approach.

The *Comparative Reports* series covers a variable number of countries, depending on the availability of data sets. Where possible, data from previous DHS surveys are used to evaluate trends over time. Each report provides detailed tables and graphs organized by region. Survey-related issues such as questionnaire comparability, survey procedures, data quality, and methodological approaches are addressed as needed.

The topics covered in *Comparative Reports* are selected by MEASURE DHS staff in conjunction with the U.S. Agency for International Development. Some reports are updates of previously published reports.

It is anticipated that the availability of comparable information for a large number of developing countries will enhance the understanding of important issues in the fields of international population and health by analysts and policymakers.

Ann Way
Project Director

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Executive Summary

This report provides an overview of major fertility trends in sub-Saharan Africa in the second half of the 20th century. It also presents the proximate determinants (factors that have a direct mechanical effect on fertility levels) and the socioeconomic correlates of these trends.

Cohort and period fertility trends were constructed using World Fertility Survey (WFS) and Demographic and Health Surveys (DHS) data sets for 31 countries in sub-Saharan Africa. Cohort trends were derived from WFS and DHS data for some of the factors that affected fertility change: infertility, age at first marriage, education level, proportion Muslim, proportion Christian, proportion living in a polygynous union, and nutritional status. Period trends were derived for urbanization and income per capita from other sources.

Cohort fertility was higher among women born in 1950 than in those born in 1930 but tended to decline in women born in later years. Changes in cohort fertility levels were small, on average. The mean number of children ever born to a woman by age 40 increased from 5.9 in women born in 1930 to 6.2 in women born in 1950 and decreased to 5.6 in women born in 1970. In most cases, the increase in cohort fertility was apparently due to a decline in infertility and, to a lesser extent, decreasing age at first marriage, which was associated with the spread of monotheist religions in the first half of the 20th century. Nutritional status did not have any identifiable impact on cohort fertility.

Like cohort fertility, period fertility tended to rise from 1950 to 1975 and then fall until 2000 or later. On average, for the countries investigated, the total fertility rate at age 40 increased from 5.3 children per woman in 1950 to 6.2 in 1975, then declined to 4.9 in 2000. The decline in period fertility appeared to be due primarily to increasing contraceptive use and, to a lesser extent, rising age at first marriage and increasing urbanization. A regression model of the explanatory variables indicated that 37 percent of the decline was attributable to increased contraceptive use, 24 percent to decreased age at first marriage, and 16 percent to increased urbanization. These three variables correlated with level of education and, to a lesser extent, income per capita.

The dynamics of the fertility decline were different in urban and rural areas. On average for the countries investigated, the trends in urban and rural areas started to split in approximately 1960. The date of onset of the fertility decline varied greatly by region and country, ranging from the early 1960s in the first urban areas to the late 1990s in the last rural areas. A few rural communities had not started the transition at the time covered by the last available survey.

The speed of the fertility decline, approximately 1 child per decade, also varied markedly among countries, from 1.5 children per decade to less than 0.5 children per decade. In addition, a stall in fertility decline occurred in six of the countries investigated (Ghana, Kenya, Madagascar [urban areas], Nigeria, Rwanda-rural, Tanzania [rural areas]); in five of these countries, this stall occurred in 1995-2005.

The pattern of the fertility decline in sub-Saharan Africa did not appear to be very different from that of many other countries in the world. However, the fertility decline in sub-Saharan Africa seems to have been somewhat more influenced by changing nuptiality patterns than elsewhere, and its relationship with socioeconomic correlates was somewhat less influenced by income levels and trends than other countries.

The appendices present a detailed analysis of fertility trends by country, with information on trends in urban and rural areas, premarital and marital fertility, and periods of monotonic changes.

Key Words: Fertility transition, fertility decline, fertility increase, fertility stall, infertility, contraception, age at marriage, proximate determinants, socioeconomic correlates, sub-Saharan Africa

1 Introduction

Most countries in the world underwent a marked fertility decline during the 20th century (United Nations, 2007a; United Nations 2007b). This major phenomenon in human history swept across cultures and religions and has had—and will have—enormous consequences for the ecological balance between humans and the environment.

The fertility decline is closely associated with the modernization process. However, it also occurred in communities with high and low incomes, high and low industrialization levels, and high and low urbanization levels. The period of fertility decline was sometimes preceded by a period of fertility increase for a variety of reasons; this typically occurred in regions in which the health of young women improved before they adopted contraception (Dyson and Murphy, 1985; Dyson and Murphy, 1986).

Fertility transitions, or steady declines in the fertility rate, are often quite rapid, spanning just two generations (50 to 60 years). This was the case in many European countries, where the fertility transition occurred between 1880 and 1930. The fertility transition was somewhat more rapid in some East Asian countries (Japan, China, Taiwan, and Korea) due to the spread of modern contraception after 1960 and the wide use of sterilization in the cases of Thailand and China. The transition was somewhat slower in some South Asian countries (India and Pakistan). As in Europe, the fertility transition in Latin America lasted approximately 50-60 years. Of course, the date of onset and the speed of the decline differed among countries.

Less research has been conducted on fertility transitions in sub-Saharan Africa. This lack of research is primarily due to the lack of routinely collected vital registration data, the main source of data used to document a fertility transition. In addition, the fertility decline in this region was more recent and less striking than in such countries as Thailand or China.

Although sub-Saharan Africa lacks vital registration data, other data sources are available to describe the fertility transition in these countries. These data sources include censuses and surveys that often collect information on fertility (children ever born for cohort fertility and births in the past 12 months for period fertility) and, more importantly, demographic sample surveys from the large international programs: the World Fertility Survey (WFS) and the Demographic and Health Surveys (DHS). The WFS and DHS surveys collect data on maternity history that can be used to derive period and cohort estimates.

Several authors have tried to document the fertility decline in sub-Saharan Africa (Caldwell et al., 1992; Caldwell, 1994; Castro-Martin, 1995; Cleland et al., 1994; Gaisie, 1996; Gould and Brown, 1996; Lesthaeghe and Jolly, 1995; McNicoll, 1992; National Academy of Sciences, 1993; Ngom and Fall, 2005; United Nations, 2001; van de Walle and Foster, 1990). Several methods have been used to document the onset of the fertility decline in sub-Saharan Africa. Cohen (1998) compared cohort (parity) and period fertility (total fertility rate [TFR]) to analyze the transition in Botswana, Côte d'Ivoire, Ghana, Kenya, Lesotho, Namibia, Sudan, Tanzania, and Zambia. Kirk and Pillet (1998) applied Bongaarts' model to many sub-Saharan African countries to document the impact of contraceptive use on fertility trends. However, few of these studies focused on the timing of the transition (the onset), urban-rural differences in fertility dynamics, or events that preceded the decline.

The aim of this study is to systematically describe the fertility changes in sub-Saharan Africa by focusing on periods of monotonic changes (fertility increase, fertility decline, or fertility stall) and to relate these dynamics to trends in the proximate determinants of fertility and various socioeconomic correlates of the modernization process. This research is an update of earlier work on the timing of the

fertility transition (Garenne and Joseph, 2002). This study includes more recent data, a more detailed analysis of the earlier data, and a more comprehensive study of the determinants of fertility change.

In the first part of this report, the main focus is to define the onset of the fertility decline in sub-Saharan Africa based on the data, without reference to any preconceived idea or theory. The second part of the report focuses on determinants and correlates, again as they appear in the data and without any reference to a given theory. This agnostic attitude opens the possibility that several factors could explain the fertility declines, increases, and stalls. This study is, therefore, primarily descriptive and is not intended to be a formal evaluation of health policies, such as family planning program policies. However, the study does indirectly provide some information on the effects of such programs on fertility trends.

2 Data and Methods

2.1 Fertility Data

The reconstruction of fertility trends was made possible by the availability of maternity history data collected by the WFS, which includes 10 surveys in sub-Saharan Africa, and the DHS, which had issued data from 74 surveys in sub-Saharan Africa as of the spring of 2007. Data from more surveys are issued regularly, so more data that can be used to analyze fertility trends in sub-Saharan Africa will become available in the future. The DHS surveys cover 35 countries in sub-Saharan Africa and will cover even more countries in the future.

Several countries were excluded from the final analysis. Specifically, Sudan was excluded because its data cover only ever-married women, so the data cannot be used to estimate premarital fertility levels and trends. South Africa was also excluded because this country's fertility trend has already been analyzed using numerous censuses and surveys (see reviews by Caldwell and Caldwell, 1993; Mostert et al., 1988; Moultrie and Timaeus, 2003; Swartz, 2003; as well as local studies by Camlin et al., 2004; Garenne et al., 2007). Estimates were included from some of these other studies for South Africa in the totals for sub-Saharan Africa. Finally, Mauritania and Eritrea were excluded from the final analysis because these data are restricted for use. With the exception of South Africa, the inclusion criterion for this study was the availability of WFS or DHS data for all women age 15-49. The list of countries and surveys used in this analysis is available in Appendix A and the data on each country are summarized in Appendix B.

To estimate trends before the earliest data from the WFS and DHS surveys, demographic census and survey data were used from other sources. These data are also useful for confirming upward trends. Details on these sources are provided in Appendix B.

2.2 Methods for Reconstructing Fertility Trends

The two main fertility indicators studied were the completed family size (CFS), or the mean number of children ever born (CEB) to a woman at the end of her reproductive period (cohort estimate), and the total fertility rate (TFR), or the sum of the age-specific fertility rates in a given year (period estimate). The terms CFS and CEB are used interchangeably throughout this report.

The first step in this study was to reconstruct period and cohort fertility trends for each selected sub-Saharan African country. In this study, period fertility appears to be more suitable for documenting fertility declines, whereas cohort fertility appears more suitable for documenting fertility increases, primarily because data on CFS are available for older women and therefore cover earlier periods.

Calculating Period Fertility

Age-specific period fertility rates were first calculated for each survey and each year for the 15 years prior to each survey from all the WFS and DHS surveys available. The cumulated fertility rate at age 40, TFR(40), was derived from the age-specific fertility rates using standard formulae with five-year age groups and one-year time periods. The main reason for calculating TFR at age 40 was to include trends over time because TFR(40) could be calculated for the years prior to the survey (see Garenne and Joseph, 2002, for more details). TFR(40) can easily be converted to classic TFR(50) by dividing the TFR(40) by 0.90, because 90 percent of total fertility occurs before age 40, a value based on the average of all DHS data available for sub-Saharan Africa. Data from the same country and the same year were combined by adding the numerators (number of births) and the denominators (number of women). Separate calculations were made for urban and rural areas.

Calculating Cohort Fertility

Cohort fertility, defined as the number of children ever born (CEB) to a woman by age 40, CEB(40), was calculated from birth history data and the calendar year of the woman's birth (cohort). For women who were age 40-49 at the time of the survey, CEB(40) was calculated by including only births that had occurred before age 40. For women age 35-39, a correction factor was applied to extrapolate CEB(40). Cohort fertility was calculated for each country as a whole, and not for urban and rural areas separately, primarily because cohort fertility for earlier periods was used when urbanization was very limited. In addition, other cohort fertility data from census and surveys were not available for urban and rural areas separately. More details on this procedure are provided in Appendix B.

Identification of Monotonic Periods of Fertility Change in Urban and Rural Areas

To identify monotonic periods of fertility change in urban and rural areas, time trends in TFR(40,t) were fitted by linear regression on year (t) using the ordinary least-square method. For this procedure, a TFR(40,t) calculated from the number of births before age 40 at time (t) [B(40,t)] was considered to be equivalent to the CFS of a cohort of N=B/TFR women with the same TFR and the same number of births. When a slope changed from positive to negative, no slope to negative, or negative to nil (fertility stall), the change in slope was tested using standard t-tests. This made it possible to formally identify periods of monotonic change (fertility decline, fertility increase, or fertility stall). Trends in period fertility were calculated for each country as a whole using the weighted average of urban and rural trends and the weights for the urban proportion from the United Nations Population Division database.

A similar procedure was used to test cohort fertility trends directly with a linear regression model. Periods of monotonic cohort fertility trends were identified and tested with the same methods used for period fertility, although only for each country as a whole and not for urban and rural areas separately.

Premarital and Marital Fertility

The proportion of premarital births, defined as the proportion of births occurring prior to the first marriage or to never-married women, was calculated directly from the WFS and DHS survey results by country and year. The results from each country were aggregated by cumulating premarital births for each year. Time trends were fitted in the proportions of premarital births using a linear-logistic regression model and monotonic periods of change in the proportions of premarital births were defined. Lastly, the fitted proportion of premarital births was applied to the reconstructed TFR(40) trend to obtain the trends in premarital fertility. In this analysis, only trends in period premarital fertility, as opposed to cohort premarital fertility, were considered.

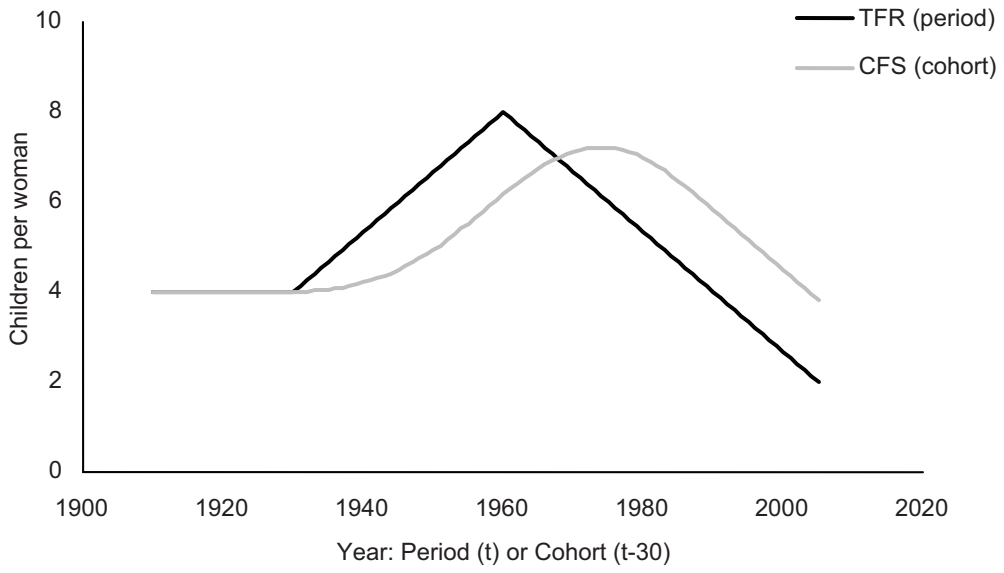
Matching Trends in Period and Cohort Fertility

The approach to studying fertility trends was to have an agnostic attitude toward the data; in other words, no a priori assumptions were made, such as hypothesizing a stable population (constant fertility and mortality) before analyzing the data. As shown below, many sub-Saharan countries followed a typical pattern of a roughly constant, or modest increase in fertility before 1950; a substantial rise in fertility in the 1950s and 1960s; and then a decline that usually started in urban areas before reaching rural areas a few years later. The countries studied varied in their baseline fertility level, magnitude of increase, speed of decline, and time lag between trends in urban and rural areas.

Before embarking on the analysis of empirical evidence, the effect of the patterns of increases and decreases in the fertility level was studied within a few decades on the two main available indicators, the CFS and TFR. To do this, a basic theoretical model was built in which age-specific fertility rates (those of Zambia) were constant for 35 years to obtain a baseline rate. The rates in the model then rise for 30 years and decline for the next 30 years, so that the TFR increases from four children per women in 1930 to

eight in 1960 and decreases to two in 2005. In this model, the age pattern for fertility remains constant over time. Under these hypotheses, CFS increases with time, with a time lag of approximately 15 years compared to TFR, reaches a lower maximum of 7.2, then intersects with the TFR before decreasing, again with a time lag (Figure 2.1). This type of pattern has already been described for the fertility transition (Ryder, 1983).

Figure 2.1 Correspondence Between Cohort and Period Fertility Estimates over Time



The country case studies in Appendix B reveal that the pattern shown in Figure 2.1 is the most common pattern throughout sub-Saharan Africa, even though its amplitude varies considerably from country to country. The magnitude of the changes should not be underestimated because 50-percent increases or declines occurred in many sub-Saharan countries over short periods of time. Some of these rapid changes were confirmed by independent information, such as the proportion of infertile women (see, for example, the Gabon case study in Appendix B).

Supplementation with Other Data

In addition to WFS and DHS microdata available from Macro International Inc., CFS estimates were used from census and survey data published in the *United Nations Demographic Yearbook* (in particular the special issues of 1978, 1997, and 2000) and original documents available at the Centre Français sur la Population et le Développement (CEPED) library in Paris. Details on the data sources used for each country are provided in Appendix B and summarized in Appendix C. Whenever possible, raw and uncorrected data were used for CFS but it was not always possible to use uncorrected data for TFR because many publications provide few details on how these data were obtained. Furthermore, in many cases, the values presented as the "official estimates" are the product of complex adjustment procedures, usually based on models (such as the Brass parity/fertility ratio) and a series of hypotheses. The authors of

these reports often hypothesized a stable population or at least constant fertility; this assumption was clearly disproved in cases of increasing fertility.

Inconsistencies were often found among published data on CEB. Some of these inconsistencies occurred in the census or survey data themselves, while others arose from calculations of the estimates. A recurrent problem in many sub-Saharan African censuses is the treatment of missing values, that is, the value attributed to women for whom no data on CEB are available (unknown category). Estimates of CFS can vary widely depending on whether data on these "unknown" cases are ignored (and therefore implicitly assumed to be the average CEB level) or these women are considered infertile (no child ever born at the time of the survey). For some age groups, especially younger women, it is likely that most women who are coded as "unknown" never had any births, whereas the opposite is true for older women. This seems to explain the inconsistencies among some of the Kenyan census results, as well as problems in a recent census of South Africa. When inconsistencies were too large, they were simply ignored in the final analysis. Only in-depth studies of the censuses could resolve these issues. Such studies are becoming possible with the free access to census data offered by the Integrated Public Use Microdata Series–International (IPUMS International), a project based at the University of Minnesota, aimed at disseminating census microdata from countries throughout the world.

2.3 Trends in Proximate Determinants

Cohort and period trends were used to analyze the impact of proximate determinants of fertility, which were calculated from WFS and DHS survey results. Only the proximate determinants found in these surveys were analyzed and other determinants were ignored because of the lack of data, which was especially true for induced abortion. In this analysis, time trends and intensity of exposure were more valued than levels per se, so the indicators used are sometimes different from some of the more common indicators used in demography.

Contraceptive Use

The "contraceptive use" indicator refers to the proportion of women who had ever used modern contraception by age 40. This measure of lifetime exposure to contraception was used to explain cumulated fertility by age 40. Contraceptive use was calculated directly from the WFS and DHS data for women age 35-49 years at the time of the survey. The data were tabulated by yearly birth cohort and the data were converted into the proportion of women age 40 that had ever used modern contraception using a logit-linear relationship. Trends were extrapolated backward to estimate the contraceptive prevalence among older cohorts, again assuming a logit-linear pattern.

No evidence of reversals in trends for contraceptive use was found in any of the countries investigated. Once contraceptive prevalence started to increase, it continued to increase until the last time point for which data were available.

The cohort estimates were converted into period estimates by multiplying the cohort estimates by a standard age pattern of fertility (the average for sub-Saharan Africa) and applying the results to 30 years after the birth cohort; these computations were completed for each country. This procedure furnishes a robust measure of exposure to modern contraception and the full trend for contraceptive use by year for up to 5 years before the last survey. The period estimates are different from the classic "contraceptive prevalence" estimates for women age 15-49 calculated in demographic surveys because the weights used were proportional to age-specific fertility rates, not to the population's age structure.

Age at First Marriage

The median age at first marriage was calculated by yearly birth cohort for all cohorts for which these data were available. The median age was defined as the age at which half of the cohort was ever married. Therefore, the definition of median age used in this report differs somewhat from the classic "median age at first marriage," which takes into account only those who ever marry or who marry by age 50. In theory, it would have been more accurate to use the proportion of women who had never married by age 40, but this would have led to a far more restrictive time dimension for the process. Because median age at first marriage, which is indeed closely related to the proportion of women who will eventually marry, was used, the full range of information available was used for some of the 25 yearly birth cohorts (age 25-49 at the time of the survey) for which data were available. Period estimates were also derived for median age at first marriage by multiplying the cohort estimates by the standard age pattern of fertility. The result was applied to the period corresponding to 30 years after the cohort's birth.

Infertility

Infertility was defined as the probability that a woman had had no live birth by age 40. This definition differs from definitions used by other authors (Frank, 1983; Larsen and Raggers, 2001), such as the probability that a woman had not had any live birth within seven years of marriage while not using contraception (known as marital infertility or marital sterility). Based on this definition, women with sterility (the biological incapacity to deliver a live infant) and voluntary infertility (by abstinence or contraception) would be considered infertile. However, voluntary infertility appears to be rare in Africa, at least compared to Western Europe, where it can be as high as 10 to 25 percent.

Infertility was calculated by yearly birth cohort for women age 35-49 at the time of the survey. Infertility rates by age 40 were calculated directly for women age 40-49 and used a conversion factor for women age 35-39. Period estimates were not used in this analysis because the changes in infertility were small in the most recent period (the years since 1975).

Nutritional Status

The mean height of adult women was used as an indicator of nutritional status because a woman's height does not change after age 20. This made it possible to calculate cohort estimates directly for all women age 20-49 at the time of the survey by year of birth. Mean height is not modulated by age effects, as is the case with body-mass index. The plain measure of height (in centimeters) is a good indicator of past malnutrition during childhood and adolescence and could be related to fertility because poor nutritional status reduces fecundability. It should be noted that height also depends on genetic characteristics and is likely to be heterogeneous among the many sub-Saharan African ethnic groups. However, this should not affect trend estimates, which are the critical factor for this analysis. Data on women's height is available only in recent DHS surveys.

Because nutritional status was used as an explanatory variable only for fertility increases, no attempt was made to convert it into period estimates.

2.4 Trends in Socioeconomic Correlates

Cohort and period fertility trends were used to analyze socioeconomic correlates of fertility. Most explanatory variables were calculated from WFS and DHS surveys, but the estimates of urbanization and income per capita were derived from other sources (see Appendix B for details on the sources used).

Education Level

The mean number of years of schooling by birth cohort was computed for all women age 15-49. For women age 15-19, a small adjustment was made to convert actual years of schooling into mean number of years of schooling by age 20. Few changes in number of years of schooling were assumed to occur after age 20 because this appears to be true for the female sub-Saharan African population as a whole, although it is not always true at the individual level. Period estimates were calculated in the same way as for the other variables, by multiplying cohort estimates by a standard age pattern of fertility and applying the result to the period corresponding to 30 years after the cohort's birth. Therefore, the period estimates in this report are different from the average number of years of schooling in the population age 15-49 in censuses and surveys.

Urban Residence

Cohort estimates of the proportion of women living in urban areas were calculated directly from the WFS and DHS data for all cohorts of women age 15-49. No attempt was made to make any corrections by age. The period estimates of urban residence used in this report came from the 2006 United Nations Population Division estimates (United Nations, 2007a). The data from these different sources do not match because the United Nations data are based on census estimates. However, the levels and trends from all of these sources are similar for all of the countries investigated. The correlation of urbanization levels by country between both sources was high ($r = 0.91$). The average levels of urbanization were somewhat higher in the cohort estimates (25.4 percent on average for the 1930-1970 cohorts versus 22.8 percent for the 1960-2000 cohorts). The slopes tended to be somewhat lower in the cohort estimates, primarily because women sometimes migrate to urban areas during their reproductive years.

Religion

Most of the WFS and DHS surveys provide data on religious affiliation. The proportion of women who were Christian or Muslim at the time of the survey was calculated by yearly birth cohort. In the regression analysis, the reference category was therefore the "other" category (neither Christian nor Muslim), which covers the traditional religions, other religions, and unknown religion. No attempt was made to convert the religious affiliation data to period estimates.

In earlier work on trends in age at marriage, monotheist religions were found to be associated with age at first marriage (Garenne, 2004).

Type of Marriage

The WFS and DHS surveys include data on type of marriage (i.e., monogamous versus polygynous). The proportion of women who were in a polygynous union was tabulated by yearly birth cohort. No attempt was made to control for age or to convert these data into period estimates.

In earlier work on trends in age at marriage, polygyny was found to be associated with age at marriage (Garenne, 2004).

Income per Capita

The last factor included in this study was income per capita, measured by the gross domestic product in purchasing power parity (GDP-PPP) using constant currency (1990 U.S. dollars [USD]). Period data are available for all years from 1950 to 2001 for all countries investigated; these data were obtained from the Organisation for Economic Co-operation and Development (Maddison, 2003).

Calculating Estimates for Sub-Saharan Africa

The country estimates were merged to produce estimates for sub-Saharan Africa of fertility trends as well as of proximate determinants and socioeconomic correlates. To merge the data on different countries, a standard weight (the 2000 population estimated by the United Nations Population Division) by country was used.

Multivariate Analysis

To identify the most salient factors in the fertility changes, several regression models were tested with both period and cohort fertility data. The first type of model links the outcome (cohort or period fertility) to the proximate determinants or the socioeconomic correlates on aggregate data by country and year, weighted by the corresponding number of women (simple linear regression model). This type of model takes into account the heterogeneity of the sub-Saharan African countries with respect to all variables and sample sizes.

The second type of model links the changes in cohort or period fertility to the changes in proximate and socioeconomic determinants after fitting the trends in the dependent and independent variables. Here again, a simple linear regression model was used. This type of model is more suitable for explaining the changes in fertility with the changes in the independent variables. These models are based on a typical longitudinal approach; therefore, their results differ markedly from those of cross-sectional models focusing on socioeconomic differentials, which are the most widely used in demography. The SPSS-11 statistical package was used for all regression analyses.

3 Results

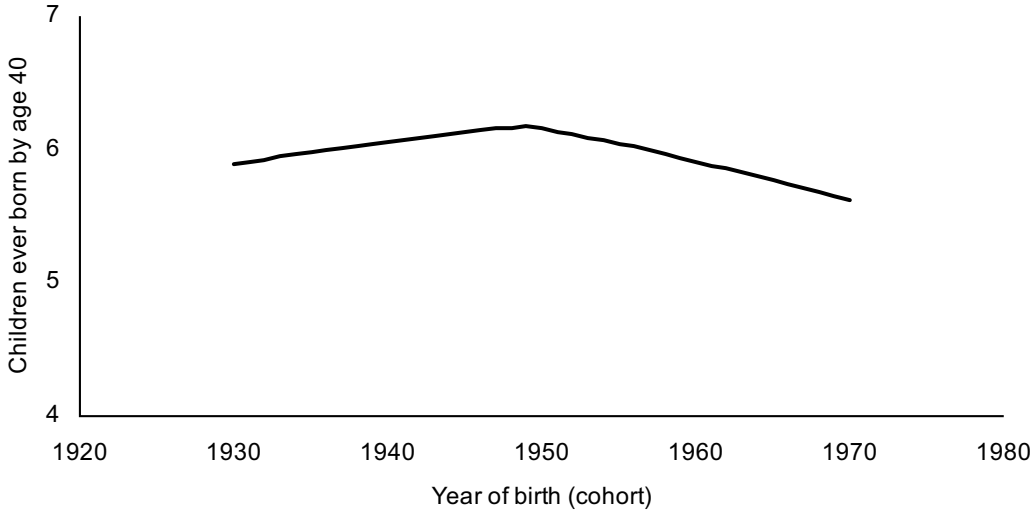
The results are presented below on cohort fertility, period fertility, urban-rural differences, premarital fertility, and fertility stall.

3.1 Cohort Fertility

Trends in Cohort Fertility

The reconstruction of cohort fertility trends from WFS and DHS data indicate an increase in cohort fertility followed by a decline. On average, the estimated CFS(40) in the selected countries rose from 5.9 children per woman born in 1930 to 6.2 children per woman born in 1950, then declined to 5.6 children per woman born in 1970 (Figure 3.1).

Figure 3.1 Reconstructed trends in cohort fertility, 31 sub-Saharan African countries, 1930 - 1970



The overall changes in cohort fertility level are small but these data hide larger or divergent changes in some countries. For example, the fertility increase from the 1930 cohort to the 1950 cohort exceeded one child per woman in Benin (increase of 1.23 children per woman), Cameroon (1.19), Chad (1.31), and Namibia (1.26). Furthermore, cohorts experienced a fertility decline during this period in Ghana (decline of 0.36 children per woman), Kenya (-0.36), Malawi (-0.48), Rwanda (-0.62), and Togo (-0.68). More details on changes in cohort fertility levels are provided in Appendix B and Appendix C.

The 1930-1970 cohorts were covered by the WFS and DHS surveys, but no surveys have documented fertility trends in sub-Saharan Africa prior to 1930. However, estimates can be made using census data on the mean number of CEB classified by birth cohort. In countries with low numbers of CEB (these countries typically had high levels of infertility), many of the changes occurred prior to the 1930 cohort's birth. Trends in cohort fertility documented in the WFS and DHS survey results were consistent

with trends from census and other survey results in most cases, which cross-validates the results from all of these sources. Details by country are provided in Appendix B.

Major increases in CEB occurred in the infertility belt in central Africa (Central African Republic, Congo, and Gabon); in Sahelian areas (Chad and Niger); in coastal West Africa (Liberia); in eastern Africa (Mozambique and Zambia); and in the islands (Comoros and Madagascar). In a few countries (Burundi, Ghana, Guinea, Lesotho, Malawi, and Rwanda), the increase in cohort fertility was very small and hardly significant. Despite some erratic patterns in the census data, no evidence was found of any major inconsistency in trends between census and survey data and the WFS and DHS data.

Trends in Infertility

Major changes in infertility occurred in sub-Saharan Africa in the first half of the 20th century. The reconstruction using WFS and DHS data indicates a drop in the proportion of infertile women from 8.1 percent among women born in 1930 to 3.1 percent among women born in 1957-1958, followed by a small rise for cohorts that had not yet reached age 40 by the time of the last survey in each country (Figure 3.1). Despite the overall decline in infertility for the earlier cohorts, differences between countries were large. Absolute values dropped substantially in the countries most affected by infertility in the early part of the 20th century. The declines were -10.1 percent in Cameroon, -10.9 percent in the Central African Republic, -8.1 percent in Congo, -6.3 percent in Gabon, -8.8 percent in Mozambique, -5.5 percent in Niger, and -13.7 percent in Tanzania.

Increases in infertility in the later period (after 1980) occurred in some of the "infertility belt" countries (Congo and Mozambique), "late marriage" countries (Lesotho, Namibia, and South Africa) where the median age at marriage is above 23 years, and other countries (Ethiopia, Ghana, Mali, Rwanda, Senegal, and Tanzania). These recent increases deserve a separate study and are beyond the scope of this report.

For the 31 countries combined, the changes in the infertility level alone could explain the rise in cohort fertility from 1930 to 1950. The formula linking these two variables can be derived from basic equations, assuming no change in the fertility level for non-sterile women:

$$\Delta Log(CFS) = \Delta Log(1 - p_0)$$

where p_0 designates the proportion that is infertile.

In this analysis, the relative change in CFS was 0.044 and the relative change in the proportion fertile was 0.049; these values are highly consistent. However, this comparison would not apply to many countries, especially those that experienced an early fertility decline. Indeed, based on WFS and DHS data, the decline in infertility could explain the fertility decline in only seven of the countries investigated. The complex relationship between the decline in infertility and the rise in cohort fertility should be analyzed carefully by country, taking into account confounding factors and, possibly, erratic data.

Infertility in WFS and DHS Surveys and Censuses

The proportion of infertile women in the WFS and DHS survey results was compared to the census data on CEB, using the proportion of women age 35 and older who had never had any live births, classified by birth cohort. This comparison was made for all cohorts included in both the censuses and the WFS and DHS surveys in the same country.

On average for the 15 countries for which the comparison was feasible, the infertility rate (3.3 percent) measured using the WFS and DHS survey results tended to be about half the rate from the

censuses (6.5 percent). In all 15 countries, the WFS and DHS estimates were lower, with the risk ratio (census/survey) for each country ranging from 1.4 to 2.8.

The estimates from the different sources might have differed for many reasons. For example, WFS and DHS surveys typically focus on households in which women live during their fertile years, whereas censuses cover the entire population. Even if institutions are not included, infertile women could live in different types of households or could avoid answering the relevant questions in the DHS survey. Censuses might also overestimate infertility because of poorer responses to the question on number of children ever born compared to full-scale maternity histories that are likely to provide a more accurate count of births followed by a child's early death. Finally, some censuses might code women who do not answer the question on CEB as being infertile, which is why census data were not used to extrapolate the findings on infertility trends to earlier cohorts.

However, the trends in infertility were similar in the WFS and DHS survey results and the census data. The most striking declines in infertility occurred in central Africa (some are shown in Appendix B), especially Congo, Cameroon, Central African Republic, Gabon, and Zambia, as well as two countries in the Sahel, Burkina Faso and Chad.

Level of Infertility and Family Size

A negative correlation was found between the infertility level and family size at baseline (1930 cohort). When infertility exceeded 8 percent, CFS(40) was lower than 6.2 children per woman; when CEB(40) was higher than 6.2 children per woman, the infertility level was lower than 8 percent. However, some countries (Namibia, Botswana, South Africa, and Lesotho) had a low average family size (fewer than 5 children per woman) despite moderate levels of infertility (less than 6 percent). The fact that all of these countries were in southern Africa indicates that other factors, especially late marriage, played a role in the low fertility level at baseline.

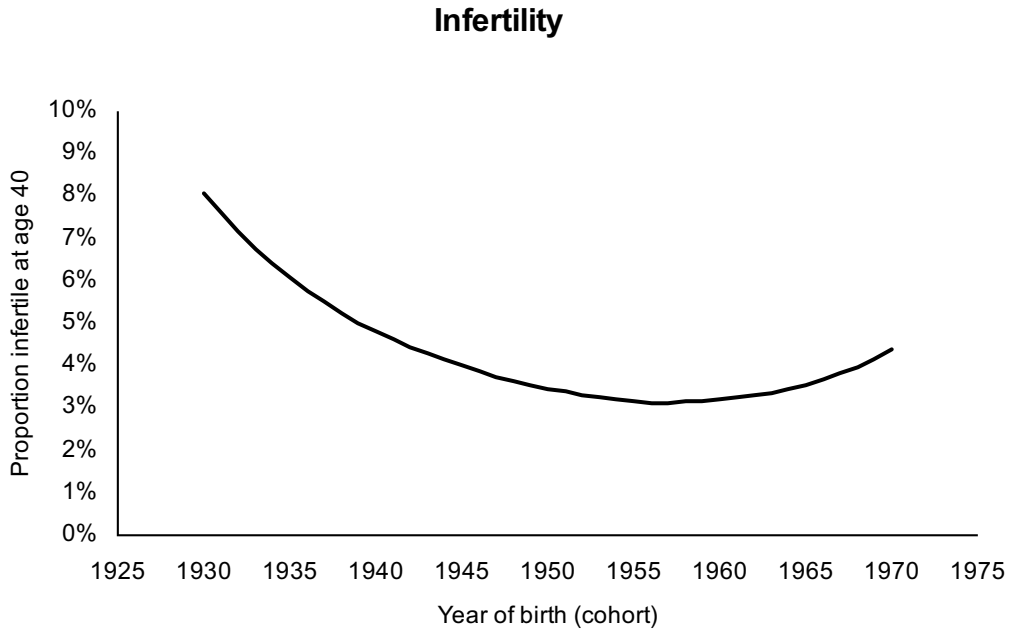
Trends in Other Proximate Determinants

The other proximate determinants of fertility examined using WFS and DHS data were contraceptive use, median age at first marriage, and nutritional status.

Contraceptive use increased steadily in the cohorts investigated, from an estimated 8 percent in the 1930 cohort to an estimated 52 percent in the 1970 cohort (Figure 3.2). Because fertility rose between 1930 and 1950, the increase in contraceptive use could explain the fertility decline that occurred after 1950 only and probably reduced the fertility increase that occurred before 1950.

The median age at first marriage changed over time, as did the proportion of women who eventually marry. Reconstructed cohort trends from WFS and DHS data show a decline in median age at first marriage from 17.6 years in the 1930 birth cohort to 17.2 years in the 1942 birth cohort, followed by a rise to 18.5 years in the 1970 birth cohort (Figure 3.2). The increases and decreases were remarkable in some of the countries; these changes have been documented elsewhere (Garenne, 2004). The trends in age at marriage were consistent with the trends in cohort fertility for sub-Saharan Africa as a whole but not with the trends in many of the countries investigated.

Figure 3.2 Reconstructed Trends in Cohort Estimates of Proximate Determinants of Fertility, 31 sub-Saharan African countries, 1930-1980



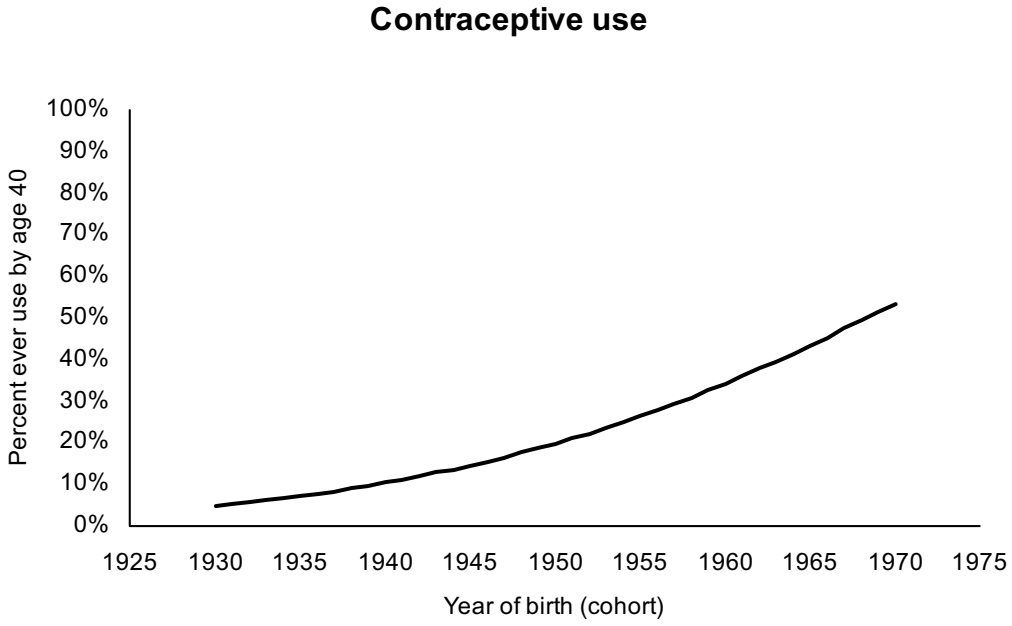
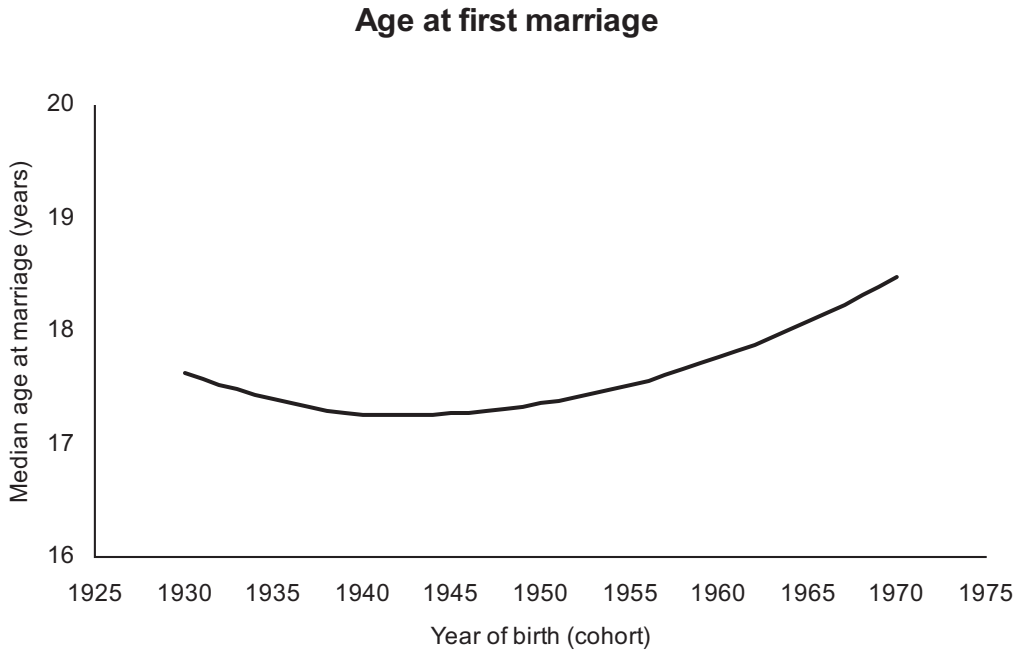
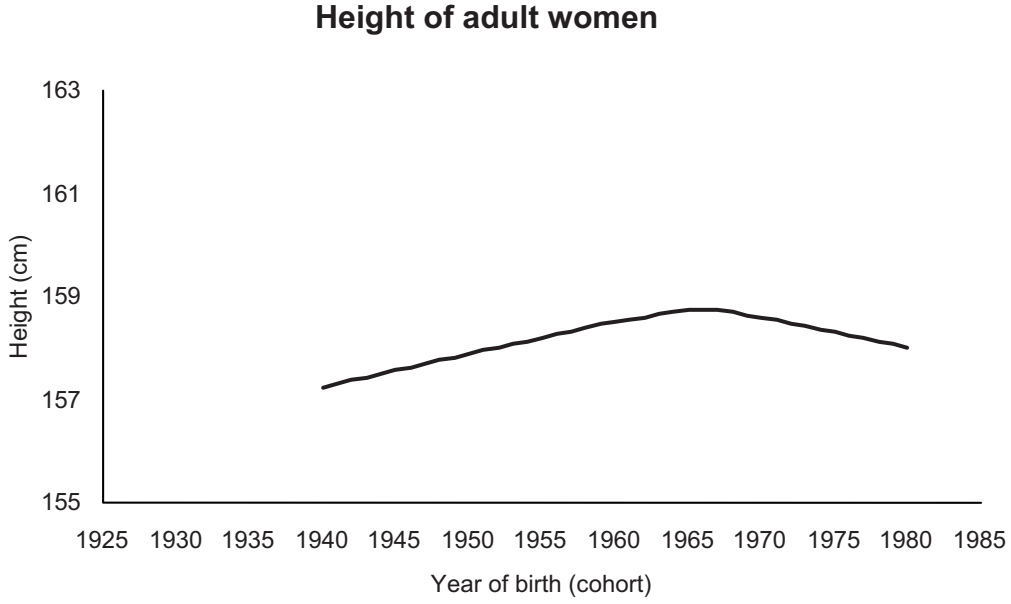


Figure 3.2 – continued





Nutritional status has also changed over time. According to DHS survey results, the average height of women born in sub-Saharan Africa in 1966, 158.8 cm, was greater than that of those born in 1940, 157.3 cm, indicating a slight improvement in nutritional status (Figure 3.2). Surprisingly, average female height stopped increasing in younger generations and even declined in Benin, Central African Republic, Congo, Madagascar, Mozambique, Namibia, Nigeria, Rwanda, Uganda, and Zambia.

Although improvements in nutritional status could have played a role in the fertility increase in sub-Saharan Africa before 1950 (but the DHS survey results do not include the 1930-1940 cohorts), nutritional status trends after 1950 were not consistent with fertility trends. The impact of nutritional status changes on fertility trend changes would have had an approximately 15-year time lag and the magnitude of the nutritional changes measured by changes in height was so small that these changes were unlikely to have had much influence on fertility.

Net Effects of Proximate Determinants

To evaluate the net effects of proximate determinants on cohort fertility in sub-Saharan Africa, two regressions linking proximate determinants with cohort fertility were run. The first regression included the three determinants (infertility, age at marriage, and contraceptive use) for which information was available for the 1930-1970 cohorts. The second regression included the same three determinants plus height; this model included only the 1940-1970 cohorts. The results show that all of these determinants have low explanatory power (Table 3.1).

Table 3.1 Net effect of proximate determinants of cohort fertility in linear regressions, sub-Saharan Africa, 1930-1970 cohorts

Variable	Beta coefficient	Standard error	T-test	P-value	Significance	Net effect
Model 1 (1930-1970 cohorts)						
Constant	10.8988	0.0873	124.85	0.0000	*	
Proportion infertile	-1.7832	0.1332	-13.39	0.0000	*	-0.026
Age at first marriage	-0.2428	0.0048	-50.76	0.0000	*	-0.099
Contraceptive use	-1.7661	0.0158	-111.86	0.0000	*	-0.222
Model 2 (1940-1970 cohorts)						
Constant	5.9853	0.2658	22.51	0.0000	*	
Proportion infertile	-0.5070	0.2166	-2.34	0.0193	*	-0.005
Age at first marriage	-0.0674	0.0087	-7.71	0.0000	*	-0.021
Contraceptive use	-2.2822	0.0227	-100.46	0.0000	*	-0.265
Adult height	+0.0114	0.0012	9.69	0.0000	*	+0.021

* $p < 0.05$

Even when all variables are significant and have the expected sign, they can account for only a small proportion of the fertility changes. In the first model, only contraceptive use appears to have had a substantial impact on fertility, with a net effect of -0.222 children for one standard deviation. The role of infertility appears to have been underestimated with this procedure, probably because of the high level of heterogeneity among the countries included in the analysis. Of course, infertility has had a major impact on the low parity in many countries in the "infertility belt."

Socioeconomic Correlates of Cohort Fertility

Similar correlations and regressions were conducted with the socioeconomic correlates of cohort fertility. Urbanization level, education level, proportion Muslim or Christian, and prevalence of polygyny

were steady over time in the cohorts investigated. Therefore, these correlates could not explain the changing fertility trends.

Only income, measured using GDP-PPP, rose and fell and could be correlated statistically with trends in fertility. GDP-PPP tended to increase in sub-Saharan Africa from 1950 to 1975 (corresponding to the 1920-1945 cohorts) and then decrease from 1975 to 2000 (corresponding to the 1945-1970 cohorts). However, these were period changes that affected the various cohorts at various ages differently. Therefore, these changes probably had a weak effect and changes in GDP-PPP were not considered in the analysis of cohort trends.

Table 3.2 Correlation coefficients between proximate determinants and socioeconomic correlates of cohort fertility, 31 sub-Saharan African countries, 1930-1970

		Proximate determinants			
Socioeconomic correlates	Fertility (CEB)	Infertility (%)	Age at first Marriage (years)	Ever used Contraception (%)	Height (cm)
Urban (%)	-0.208	-0.067	+0.028	+0.746	-0.116
Polygyny (%)	-0.040	-0.194	-0.235	+0.331	+0.023
Muslim (%)	-0.042	+0.013	-0.058	+0.217	-0.143
Christian (%)	-0.247	-0.324	+0.176	+0.866	-0.156
Education (number of years)	-0.243	-0.211	+0.210	+0.913	-0.162

Note: All correlation coefficients significant at p <0.001.

Correlations with cohort fertility level were weak for urban residence, proportion Christian, and education level; correlations were nil for the other socioeconomic correlates. The negative correlations of cohort fertility level with urban residence, Christian religion, and education level were primarily associated with contraceptive use. Infertility had only weak correlations with socioeconomic correlates; these correlations were negative for Christian religion and education level (a higher proportion of Christians and a higher education level correlated with lower infertility levels). Age at first marriage also had weak correlations with socioeconomic correlates, although these were in the expected direction (larger urban population, higher proportion of Christians, and higher education level correlated with higher age at first marriage). Surprisingly, height correlated negatively with urban residence and education in this sample, probably because of the strong ethnic heterogeneity between west and southern Africa.

Table 3.3 Net effect of socioeconomic correlates of cohort fertility in linear regressions, 31 sub-Saharan African countries, 1930-1970

Variable	Beta coefficient	Standard error	T-test	P-value	Significance	Net effect
Constant	+6.3560	0.0248	256.60	0.000	*	5.267
Proportion urban	-0.0238	0.0608	-0.39	0.696	NS	-0.001
Proportion in polygynous relationship	+1.5780	0.0453	34.82	0.000	*	0.076
Proportion Muslim	-0.6984	0.0609	-11.46	0.000	*	-0.023
Proportion Christian	-1.8747	0.0548	-34.23	0.000	*	-0.146
Level of education	-0.1737	0.0071	-24.42	0.000	*	-0.101

*p <0.05.
NS = not significant

Here again, the net effects of socioeconomic correlates were significant and in the expected direction, but their magnitude was small. Only changes in education level and proportion Christian had a discernible net effect on cohort fertility, and the effect of urbanization disappeared after controlling for education and social factors. The effect of monotheist religions should be understood in the context of social change and modernization and should be interpreted after controlling for urbanization and education.

None of the trends for any socioeconomic variable could account for the rise in cohort fertility for women born between 1930 and 1950. As a result of socioeconomic development, more women lived in urban areas, more women adhered to monotheist religions, and women had more education, all variables that could explain the fertility decline after 1950 but not the rise before 1950.

Accounting for the Cohort Fertility Increase

To account for the cohort fertility increase for women born between 1930 and 1950, the reconstructed trends were used to calculate changes in fertility and changes in explanatory variables between the 1930 birth cohort and the cohort with peak fertility; the cohort with peak fertility levels varied from country to country. Only countries in which cohort fertility increased were included in this analysis (see Appendix B for details), and the potential explanatory factors were again the proximate determinants and socioeconomic correlates described above.

A simple linear regression model was used to match the changes in cohort fertility with the changes in the explanatory variables. The model revealed that two basic factors explained the rise in cohort fertility: the decline in infertility (explaining 47 percent of the fertility increase) and the change in religious affiliation, especially the increase in the proportion Christian (20 percent increase) and Muslim (22 percent increase). These changes in religious affiliation were apparently associated with earlier marriage and therefore higher fertility in the first half of the 20th century. However, the effect of changes in religious affiliation subsequently changed and after 1950, affiliation with a monotheist religion was more closely associated with increasing urbanization and education levels (see below).

These averages for all countries combined should be interpreted with caution because they hide major differences by country. In some countries, infertility explains all changes in cohort fertility levels but in other countries, social factors seem to have played the leading role in these changes.

The fertility increase before 1950, therefore, appears to have been due primarily to health factors, especially primary infertility, that were largely independent of socioeconomic factors. In most cases, high levels of sterility were due to infectious and parasitic diseases (especially trypanosomiasis and certain sexually transmitted diseases), so that trends in infertility had their own dynamics and were the product of health policies and programs that were largely independent of social dynamics (McFalls and McFalls, 1984).

3.2 Period Fertility

Period Fertility Trends

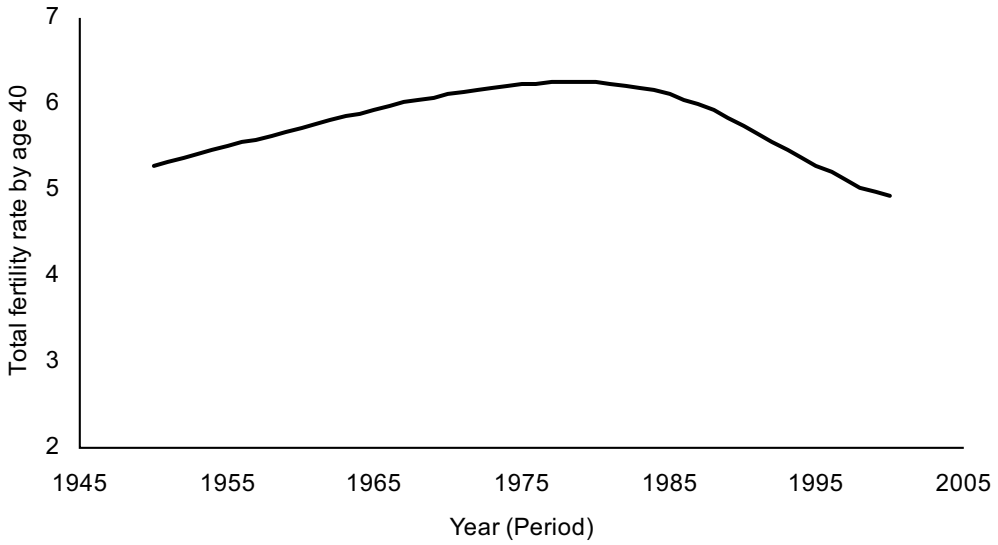
Reconstructed trends in period fertility for the 31 countries in sub-Saharan Africa indicate a rise from a TFR(40) of 5.3 children per woman in 1950 to 6.2 children in 1980, followed by a decline to 4.9 children in 2000.

These average rates hide major discrepancies in the rates for different countries. For example, period fertility rates in 1950 ranged from higher than 6.0 children per woman in Ghana, Kenya, Malawi, Rwanda, and Senegal to less than 4.0 in Gabon, Madagascar, and Mozambique. The peak values were as

high as 7.5 or more children per woman in Kenya, Burkina-Faso, Mali, and Niger or as low as 6.0 or fewer in Botswana, Lesotho, Mozambique, Congo, and Central African Republic. After 1990, levels were lowest (fewer than 3.5 children per woman) in southern Africa (Botswana, Zimbabwe, South Africa, and Lesotho) and Gabon. In contrast, TFR(40) in 2000 was 6.0 or more children per woman in the Sahelian countries (Chad, Mali, and Niger) and Uganda.

The wide ranges in fertility levels in and after 1950 are supported by census data for CEB as well as recent DHS publications.

Figure 3.3 Reconstructed trends in period fertility, 31 sub-Saharan African countries, 1950-2000



Proximate Determinants of Period Fertility

In this analysis, only two proximate determinants of period fertility could be used: contraceptive use and median age at first marriage. Average period height could not be computed because data were only available for a limited number of cohorts. Infertility could not be estimated for the 1980-2000 period because this would have required data on fertility status by age 40 for all women concerned, including the cohorts born after 1970.

Period trends in contraceptive use reflect the cohort trends described above (Figure 3.2). Contraceptive prevalence, defined as ever having used a modern method by age 40, has been increasing dramatically in sub-Saharan Africa from 3 percent of women in 1950 to 58 percent in 2000. In contrast, average median age at first marriage decreased from 17.9 years in 1950 to 17.4 in 1970 before increasing to 18.8 in 2000.

Variations among countries were remarkable. Contraceptive use was universally low in 1950, but it ranged from 6 percent to 95 percent in 2000. In Guinea, Chad, and Burundi, less than 30 percent of the population was using contraceptives by 2000, while more than 85 percent of the population used contraceptives in 2000 in southern African countries (Zimbabwe, Namibia, Lesotho, and South Africa) and Gabon.

Variations in age at first marriage were also remarkable. By 2000, average age at first marriage in Chad, Guinea, Mali, and Niger was still less than 16.5 years, whereas it was higher than 24 years in Botswana, Namibia, and South Africa.

These marked variations in the leading proximate determinants of period fertility probably had a dramatic effect on fertility levels and trends. The trend in contraceptive use was monotonic (increased steadily) but that of age at first marriage tended to increase and decrease at times that roughly matched those of changing trends in period fertility.

Net Effects of Proximate Determinants

A regression model linking period fertility to age at first marriage and contraceptive use by country and period (year) was tested. The results indicate that both proximate determinants had similar net effects and probably played symmetric roles (Table 3.4).

Table 3.4 Net effects of proximate determinants on period fertility, 31 sub-Saharan African countries, 1950-2000

Variable	Beta coefficient	Standard error	T-test	P-value	Significance	Net effect
Constant	7.8511	0.1876	41.852	0.0000	*	
Contraceptive use	-1.0434	0.1048	-9.960	0.0000	*	-0.242
Age at first marriage	-0.1024	0.0109	-9.359	0.0000	*	-0.228

* p <0.05.

Figure 3.4 Reconstructed trends in period estimates of proximate determinants of fertility,31 sub-Saharan African countries, 1950-2000

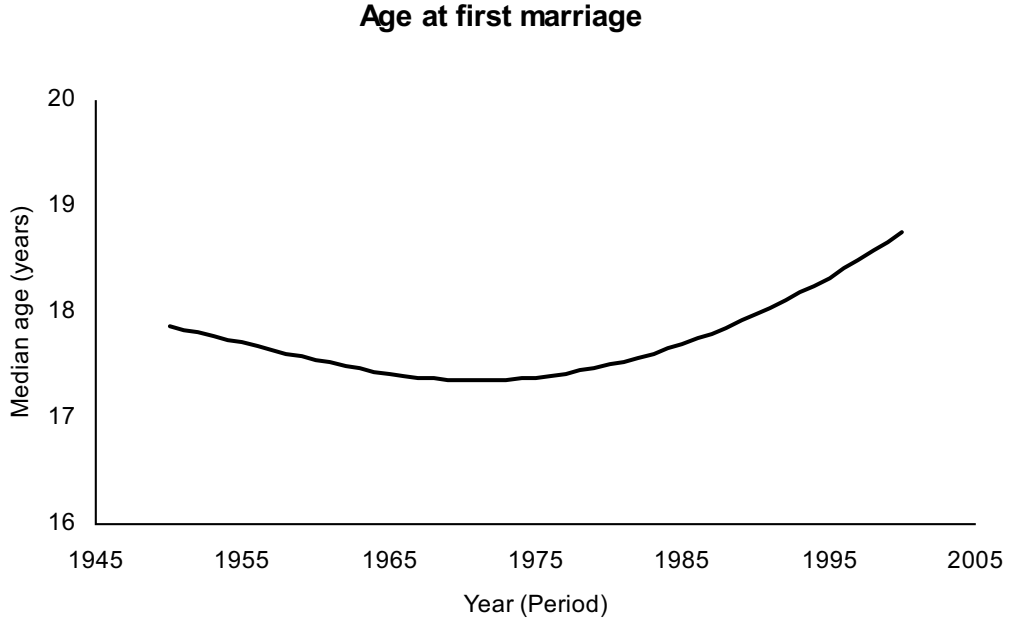
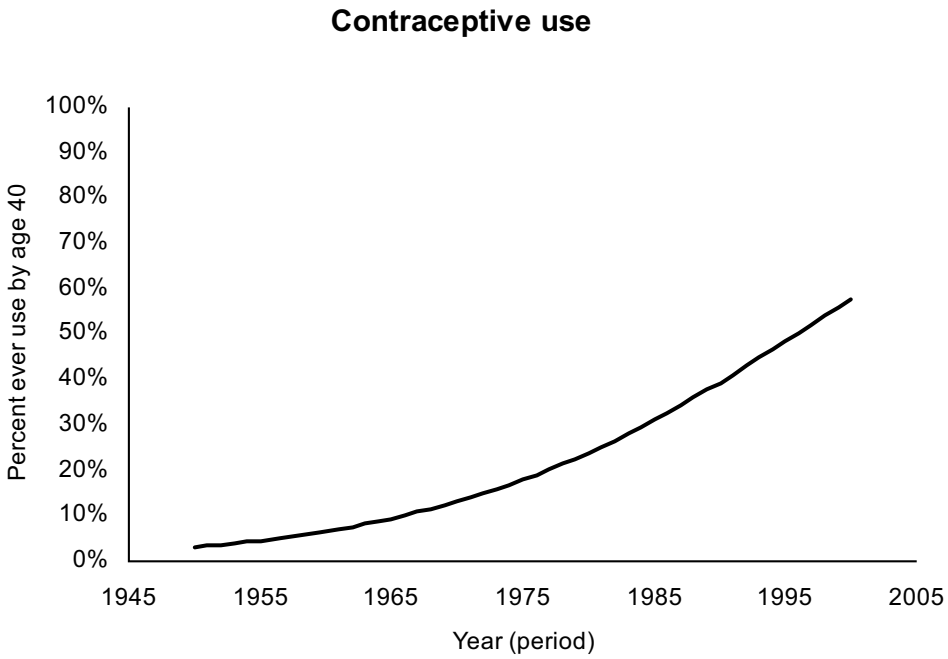


Figure 3.4 – continued



Trends in Socioeconomic Correlates

Trends in education level reflect the cohort trends in education analyzed above. In general, the trends were steady (Figure 3.5) though they tended to stagnate in the last years for which data are available in Zambia and Madagascar. Differences in education level between countries were marked; the average number of years of school was higher than seven in 2000 in Congo, Gabon, Kenya, Lesotho, Namibia, South Africa, and Zimbabwe but lower than two in Burkina-Faso, Chad, Ethiopia, Guinea, Mali, and Niger.

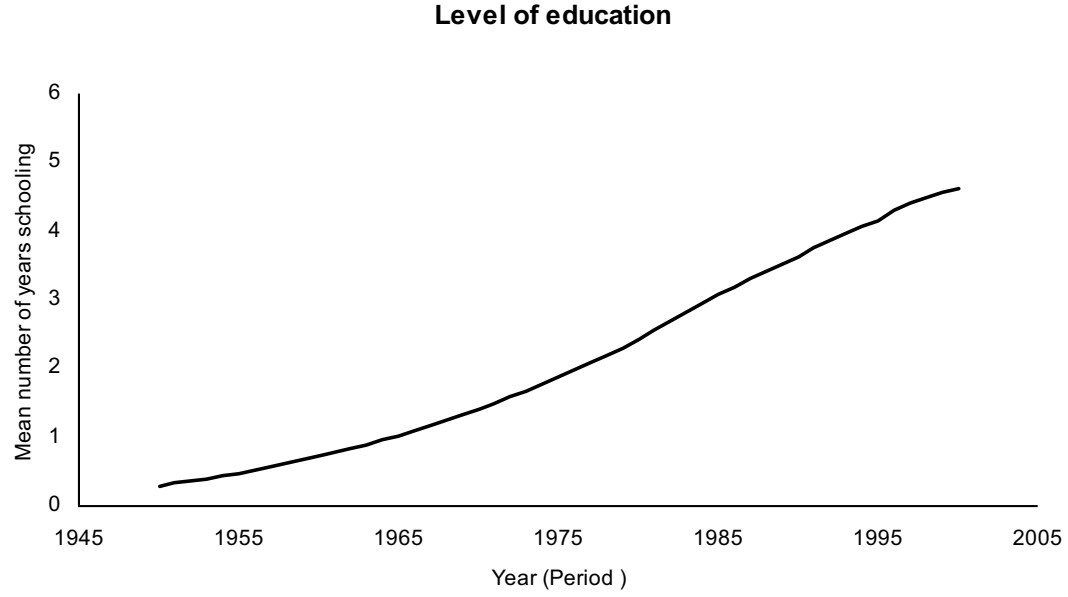
Trends in urbanization were also steady overall (Figure 3.5) and stagnated only in Zambia. The contrasts in urbanization level by country were marked. In 1950, only Congo, Senegal, and South Africa had more than a quarter of their population living in urban areas, whereas by 2000, a third of the countries had populations that were more than 40 percent urban, and more than 50 percent of the population was urban in Botswana, Congo, Gabon and South Africa. In contrast, by 2000, less than 16 percent of the population was urban in Rwanda, Burundi, Uganda, Malawi, and Ethiopia.

Trends in income (GDP-PPP) were more complex and, for the selected countries, evolved roughly (and surprisingly) in the same direction as trends in fertility. Income increased from 1950 to 1975 (when fertility was increasing), then decreased from 1975 to 1995 (when fertility was decreasing), and started to increase again after 1995.

Large differences in income levels existed among countries. At baseline in 1950, only Gabon, Namibia, and South Africa had an average income that exceeded 2,000 USD and one-third of the countries had an average income below 500 USD. By 2000, average income in Botswana, and Congo had risen to at least 2,000 USD, but average income in Chad was still less than 500 USD.

The dynamics of changes in income per capita also differed over time. In some countries, such as Kenya, growth was steady. In others, such as Senegal, growth stagnated, and yet in others, such as Niger, GDP per capita declined over time.

Figure 3.5 Reconstructed trends in period estimates of socioeconomic correlates of fertility, 31 sub-Saharan African countries, 1950-2000



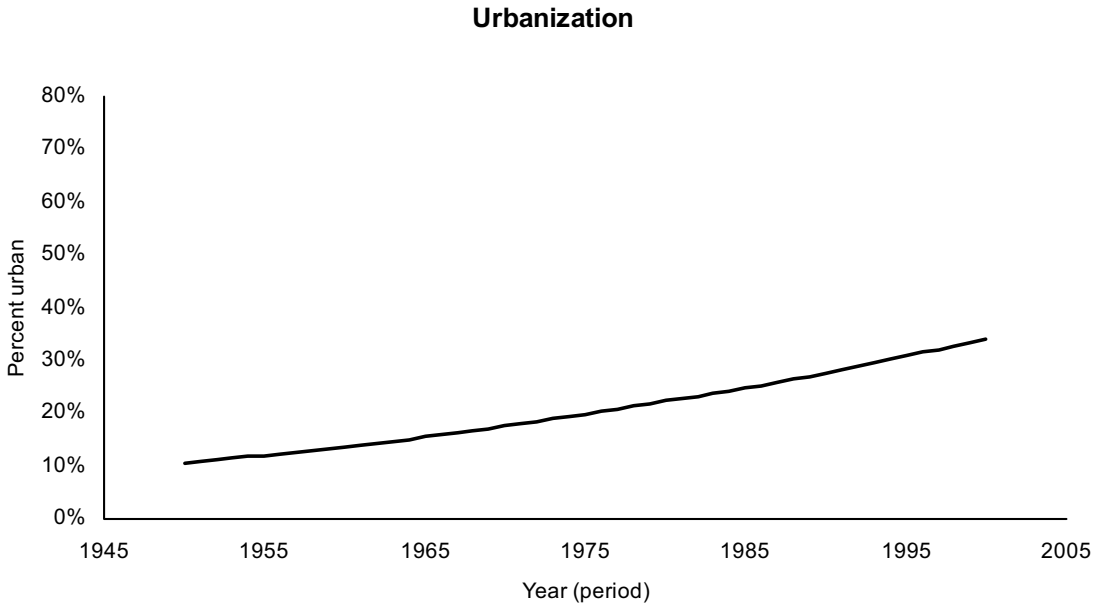
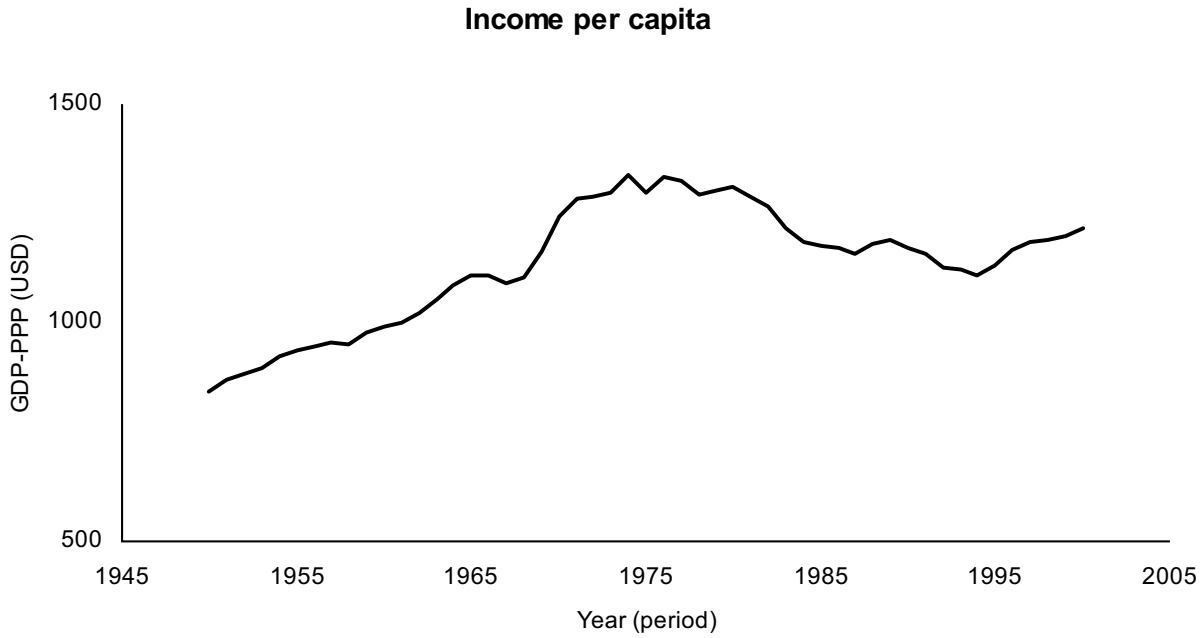


Figure 3.5 – continued



Correlation among Socioeconomic Variables, Proximate Determinants, and Fertility Levels

Correlations among socioeconomic variables, proximate determinants, and fertility levels were strong and in the expected direction (Table 3.5). Urbanization level, education level, and income per capita were all associated with higher contraceptive use rates, higher age at first marriage, and lower fertility levels. However, these averages conceal differences among countries that need to be further investigated.

Table 3.5 Correlation coefficients of socioeconomic variables, proximate determinants, and period fertility rates, 31 sub-Saharan countries, 1950-2000

Socioeconomic variable	Total fertility rate	Contraceptive use	Age at first marriage
Urban residence (%)	-0.302	0.648	0.233
Level of education (years)	-0.406	0.849	0.547
Income per capita (GDP)	-0.381	0.427	0.466

Note: All correlation coefficients significant at p <0.001.

Net Effects of Socioeconomic Correlates

A regression model linking period fertility levels to socioeconomic correlates was tested (Table 3.6). The results show that only level of education had a substantial impact on the fertility decline between 1950 and 2000. Urbanization had no effect on period fertility, even though urban fertility declined quickly during this period. Based solely on population composition, urbanization should have

had an effect on national period fertility trends. This effect is not reflected in the regression analysis because of the strong heterogeneity among countries.

Table 3.6 Net effects of socioeconomic correlates on period fertility, 31 sub-Saharan African countries, 1950-2000

Variable	Beta coefficient	Standard error	T-test	P-value	Significance	Net effect
Constant	6.25590	0.037	168.53	0.0000	*	
Urban residence	-0.00074	0.199	0.00	0.9971	NS	0.000
Level of education	-0.12535	0.013	-9.98	0.0000	*	-0.266
Income per capita	-0.00019	0.000	-8.35	0.0000	*	-0.218

* p <0.05
NS = not significant

Reasons for the Period Fertility Decline

A more convincing approach than using plain regression with levels is to study the changes between peak fertility and the last point for which data are available for each country selected. Linear regressions similar to those used for cohort fertility were run. These regressions linked the changes in period fertility to the changes in proximate determinants and socioeconomic correlates.

These models led to different and more plausible conclusions than the regression model linking period fertility to socioeconomic correlates. First, the model had higher explanatory power, explaining 77 percent of the changes in fertility. Second, the explanatory factors for fertility decline were the two proximate determinants (contraceptive use and age at first marriage) and the structural factor (urbanization). Income and education had no independent impact because their effects were probably mediated by the explanatory factors. The unexplained proportion of the fertility changes could be attributed to limitations in the model; factors not accounted for in the model, especially induced abortion; and, possibly, minor changes in infertility and nutritional status, as occurred in the cohort analysis.

Table 3.7 Net effect of changes in proximate determinants and socioeconomic correlates on changes in period fertility levels, between 1977 and 1999, 31 sub-Saharan African countries

Factors	Year of peak fertility (1977)	Last year for which data are available (1999)	Change between 1977 and 1999	Net effect	Percentage explained
Contraceptive use	0.212	0.578	+0.366	-0.647	37
Age at first marriage	17.94	19.12	+1.18	-0.416	24
Urban residence	0.214	0.334	+0.120	-0.288	16
Level of education	1.971	4.066	+2.095	+0.172	
Income per capita	1249	1335	+86	+0.004	
TFR(40)	6.594	4.829	-1.765	-1.176	77

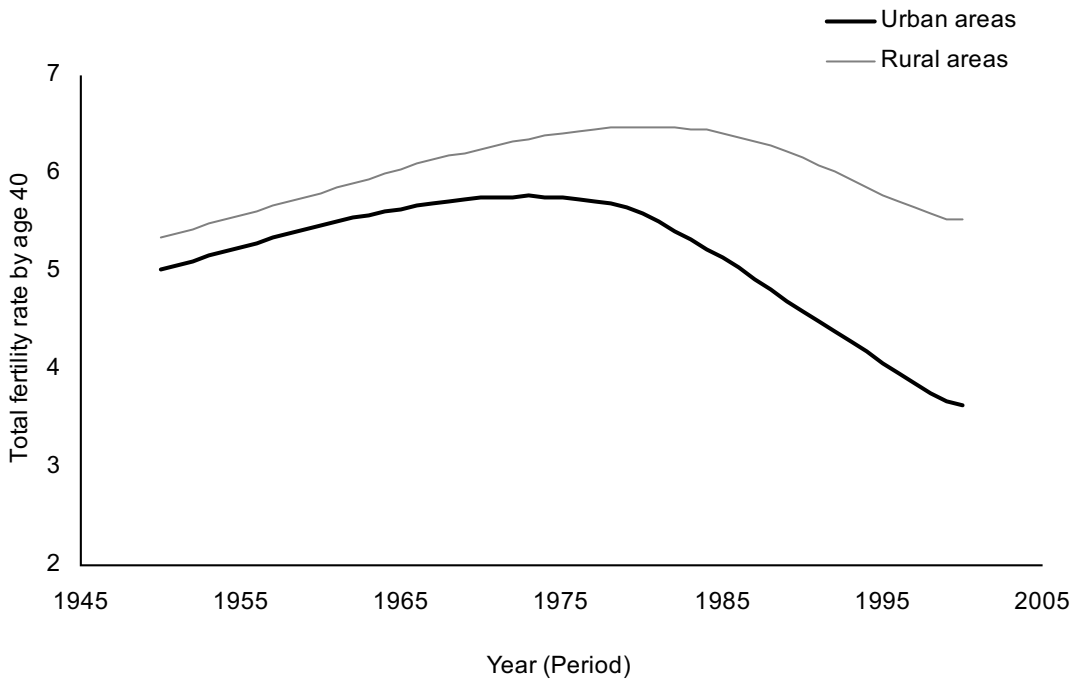
3.3 Urban-rural Divide

The main result of the country analysis was the differential dynamics of fertility trends in urban and rural areas (see Appendix B and Appendix C for details). Urban areas simultaneously concentrate differentials in proximate determinants (less infertility due to biological factors, higher age at first marriage, higher contraceptive use, better nutrition) and socioeconomic factors (more education, higher income). The differential period dynamics for the 31 countries are displayed in Figure 3.6.

Trends in urban and rural areas started to split in approximately 1960. The difference between rural and urban areas increased over time from 0.3 children in 1960 to 1.9 children in 2000. Urban

fertility began to decline in approximately 1970, when the average TFR(40) was 5.7, and the decline has been rapid, at -0.70 children per decade. In contrast, rural fertility started to decline in approximately 1980, when the average TFR(40) was 6.5, and this decline proceeded at a slower pace than in urban areas, at -0.47 children per decade.

Figure 3.6 Reconstructed trends in period fertility, by urban and rural residence, 31 sub-Saharan African countries, 1950-2000



3.4 Date of Onset and Speed of the Fertility Transition

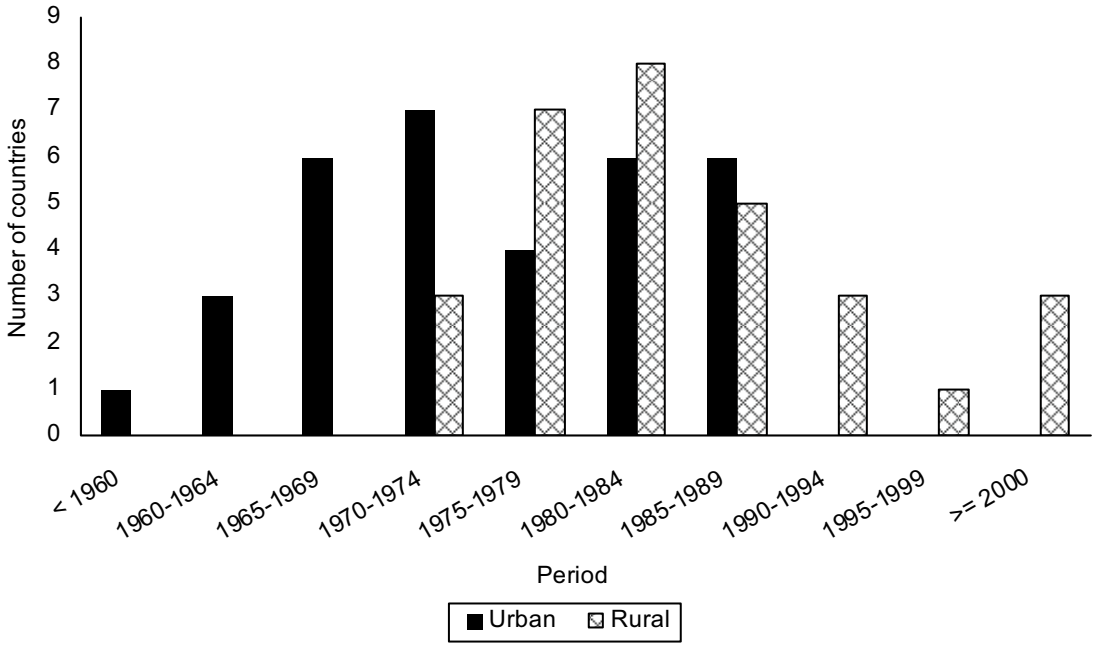
The onset of the fertility transition can be dated to either the period when rates in urban and rural areas started to split or when fertility levels began to decline in urban areas. The results show a wide range of possibilities for African countries (Figure 3.7 and Table C-2). The earliest fertility declines in urban areas began in the 1950s in South Africa; in the 1960s in Namibia, Kenya, and Ghana; and in the 1970s or 1980s in the remaining sub-Saharan African countries. The earliest declines in rural areas occurred in the early 1970s in Kenya and Zambia, followed by declines in many other countries in the 1980s and 1990s. As of 2000, fertility rates had not started to decline in rural areas of two countries (Congo and Mozambique), and trends were unknown in Burundi and Liberia. With a few exceptions, most sub-Saharan African countries underwent a fertility transition within a 50-year period (between the 1950s and 2000); this is similar to the span of Europe's fertility decline between 1880 and 1930 (van de Walle and Knodel, 1980).

The speed of the fertility decline also varied markedly among countries, from levels as high as -1.5 children per decade (Comoros in 1986-1996, Côte d'Ivoire in 1982-1998, Gabon in 1974-2000, and

Mali in 1990-2001) to lower than -0.5 children per decade (Congo in 1968-2005, Ghana in 1950-2003, Mozambique in 1988-2003, Nigeria in 1980-2003, and Uganda in 1968-2000).

The average speed of fertility decline was approximately 1 child per woman per decade (standard deviation of 0.5 children), so the typical transition from a peak of 6.5 children per woman to a low of 2.5 children occurred within approximately 40 years. The transition period was sometimes shorter in urban areas and much longer in rural areas. In some countries, the fertility transition was rapid in rural areas. For example, the transition in South Africa occurred within approximately 30 years, even in such remote regions as Kwazulu-Natal and Mpumlanga (Camlin et al., 2004; Garenne et al., 2007). However, the transition will probably take much longer in many remote rural areas of the Sahelian countries, where fertility levels are still high and the pace of change has been slow in the past 20 years.

Figure 3.7 Distribution of year of onset of the fertility transition in urban and rural areas, 31 sub-Saharan African countries, 1950-2000



3.5 Recent Periods of Fertility Stall

A few countries experienced periods of fertility stall: Ghana in 1998-2003; Kenya in 1997-2003; Madagascar in 1987-1993; Nigeria in 1998-2003; Rwanda in 1998-2005; and Tanzania in 1995-2004. All of the changing slopes for these countries were highly significant ($p < 0.05$) (Table 3.8). Researchers have studied the fertility stalls in some of these countries (Bongaarts, 2005; Shapiro and Gebreselassie, 2007), but the others merit more analysis.

Table 3.8 Fertility stall, selected sub-Saharan African countries, 1987-2005

Country/period	Mean TFR(40) during stall			P-value of changing slopes		
	Total	Urban	Rural	Total	Urban	Rural
Ghana 1998-2003	4.14	2.88	5.13	0.0001	0.0003	0.0011
Kenya 1997-2003	4.44	3.31	5.09	0.0000	0.0228	0.0000
Madagascar 1987-1993	5.73	4.29		0.0001	0.0060	
Nigeria 1998-2003	5.24	4.54	5.80	0.0000	0.0003	0.0000
Rwanda 1998-2005			5.44			0.0109
Tanzania 1995-2004			5.91			0.0215

In Ghana, Kenya, Nigeria, Rwanda, and Tanzania, the fertility stall occurred in 1995-2005 and was still ongoing at the time of the latest survey. However, the fertility stall in Madagascar was earlier, in 1987-1993, and ended after seven years. Fertility stalls occurred in both urban and rural areas in many countries, but the stall in Rwanda and Tanzania occurred only in rural areas. Agincourt, a rural area of South Africa, also experienced a fertility stall; this stall lasted only five years before fertility began declining again (Garenne et al., 2007).

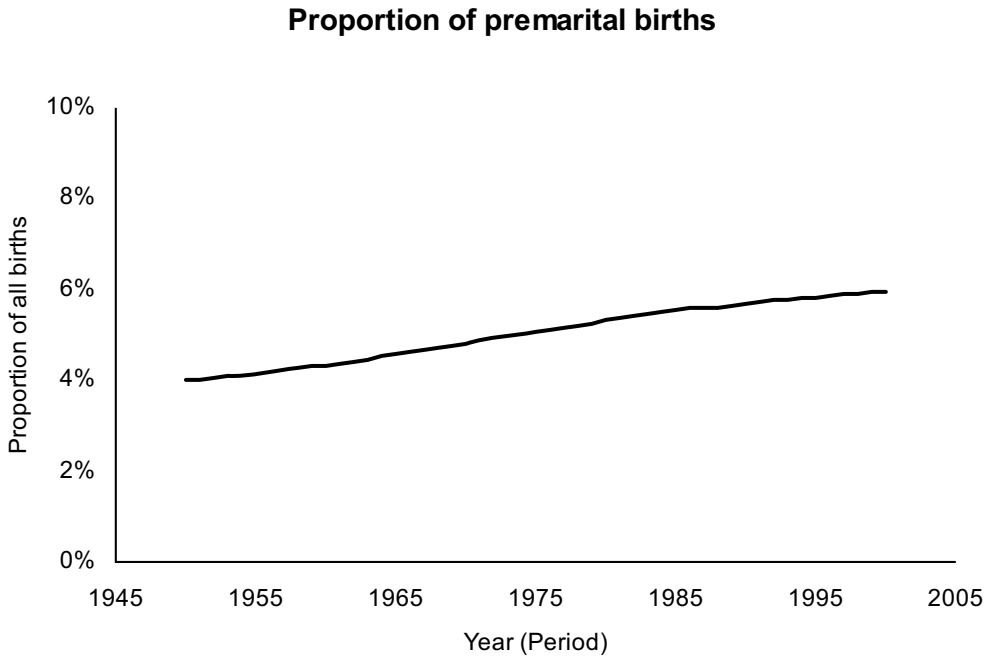
The stalls occurred at different points toward the middle of the transition, with average TFR(40) ranging from 2.9 to 4.5 in urban areas and 5.1 to 5.9 in rural areas. More research is needed on the fertility stall in each country.

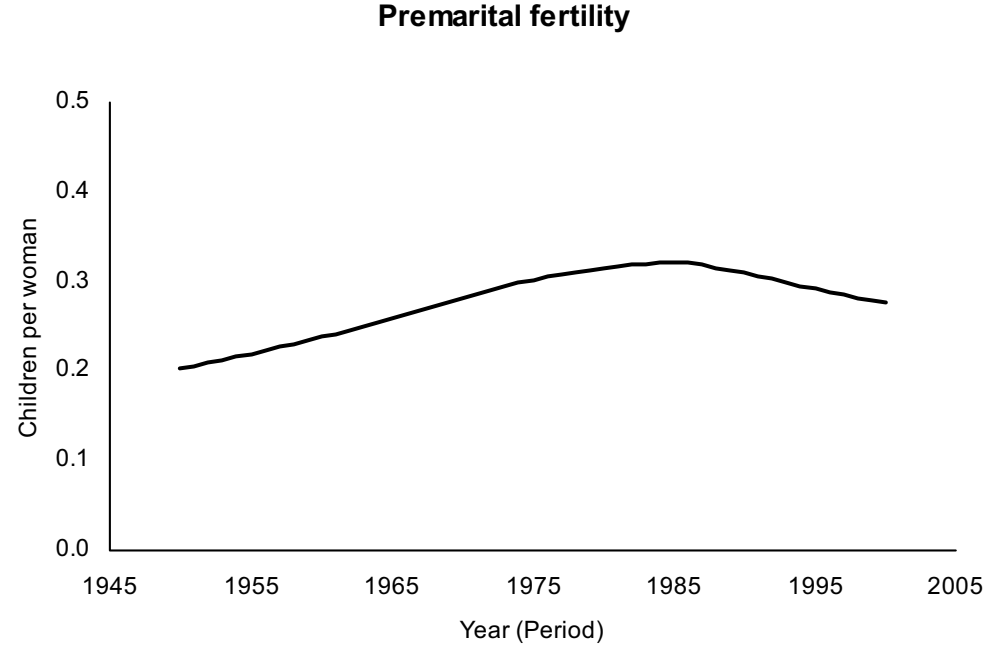
3.6 Premarital Fertility

The proportion of premarital births, defined as the proportion of births that occurred prior to the mother's first marriage or to a never-married mother, increased by 50 percent for sub-Saharan Africa, from 3.8 percent in 1950 to 5.7 percent in 2000 (Figure 3.8). This small increase hides major differences by country, with levels ranging from 0.3 percent in Niger and 0.4 percent in Chad to 44 percent in Namibia and 43 percent in Botswana. However, while the fertility decline has become pronounced, the premarital fertility rate has been declining since 1985, when the rate was 0.32 children per woman, reaching 0.27 children per woman in 2000. In addition to hiding substantial differences by country, from 0.017 to 2.06 children per woman, these average rates hide even greater differences by ethnic group.

More details on premarital fertility, especially the role of ethnicity and social factors, in sub-Saharan Africa can be found elsewhere (Garenne and Zwang, 2006).

Figure 3.8 Trends in Premarital Fertility, 31 sub-Saharan African countries, 1950-2000





4 Discussion

This study highlights the value of the WFS and DHS surveys for documenting fertility changes. By recording full maternity histories, they enable one to reconstruct period and cohort fertility trends. Furthermore, by providing information on numerous factors, these surveys allow a detailed analysis of proximate determinants and socioeconomic correlates of fertility.

The use of yearly estimates is not conventional because each yearly estimate has a large confidence interval due to the small number of births. However, by using trends over monotonic periods, researchers can take full advantage of the richness of the information and obtain more precise point estimates as well as reliable trends.

In theory, censuses could provide data comparable to those of WFS and DHS surveys, at least for cohort estimates. However, census data are rarely available by year of birth, and this limits their usefulness. Only the IPUMS International program currently provides access to census sample microdata and, so far, only six samples are available for three sub-Saharan African countries. This seriously limits the potential use of census data for comparative analyses of fertility changes.

A detailed analysis of increases and decreases in fertility levels is necessary to understand the dynamics of these changes over a 50-year period. In sub-Saharan Africa, a comparison of average fertility levels in 1950 and in 2000 is misleading because it hides the major and rapid changes that occurred in virtually all of the countries investigated. Similarly, ignoring the different dynamics in urban and rural areas would hide some of the major changes that occurred in these regions.

The fertility dynamics vary greatly by country, with some experiencing a steady and rapid fertility decline, others a steady and slow decline, others a small rise followed by a rapid decline, and still others a major rise followed by a slow decline. Identifying a typology would be difficult because the number of different scenarios is the same as the number of countries due to the different dynamics and determinants in each country.

Cases of fertility increases have been documented elsewhere (Dyson and Murphy, 1986), but the most dramatic increases seem to have occurred in the sub-Saharan African countries affected by high levels of infertility in the first half of the 20th century. The rapid reduction in infertility, still present in some of the WFS and DHS case studies, appears to have played a major role in many of the fertility increases in sub-Saharan Africa; these changes are most clearly evident in cohort fertility rates. The social changes that led to lower ages at first marriage in the first half of the 20th century also appear to have contributed to fertility increases in some of the countries investigated. These effects have rarely been documented for sub-Saharan Africa (Dyson, 1988).

Fertility began to decline in most sub-Saharan African countries in the second half of the 20th century, except for some remote rural areas. On average, fertility began to decline within only a few years of some of the more advanced developing countries of Asia and Latin America, and roughly only a century after Europe. These are small differences from a broad historical perspective, given the complex political dynamics in sub-Saharan Africa in the 19th and 20th centuries, especially the late development of political independence.

The speed of the fertility decline in sub-Saharan Africa is comparable to that of many other developing countries, such as India and Pakistan, but is lower than that of the countries with the most rapid fertility declines, such as China and Thailand. The poorest and least urbanized areas will probably take many years to reach replacement fertility levels. The fertility declines in some large African cities, such as Addis Ababa, Ethiopia, were as rapid as the fastest declines in other parts of the world (Lindstrom

and Woubalem, 2003). The slow fertility decline in remote rural areas of sub-Saharan Africa is similar to the decline in rural France in the 18th century and in the rural United States in the 19th century. The diversity of conditions in Africa appears analogous to the diversity of conditions in other parts of the world.

This analysis had limitations due to the small sample sizes and limited years covered by the WFS and DHS surveys. Some countries are covered by a WFS survey and several DHS surveys, but others are covered by only one or two DHS surveys. Some of the estimated dates for the onset of a fertility change are unstable; these values have a margin of error of approximately plus or minus five years. Similarly, the distinction between urban and rural areas trends was based on hazardous extrapolations in some cases; readers should review these distinctions with caution. Lastly, a small number of inconsistencies was found between the WFS and DHS survey data and data from other surveys and censuses. As a result, the averages may have been biased.

Another limitation of the study is the classification of urban and rural residence. Surveys and censuses identified the residence status of a woman and all of her children based on the woman's residence at the time of the interview, regardless of where she lived when each child was born. This might explain why differences between urban and rural fertility rates were very small early in the fertility transition, when urbanization was very recent and many newly urban women had given birth to several of their children in rural areas. However, by later stages of the fertility transition, a larger proportion of the population had been living in urban areas for several decades. This bias would tend to reduce the observed differences in fertility between urban and rural areas, so that the differences documented in this study are likely to be underestimates of the true differences between urban and rural fertility. Therefore, the increased urbanization of women in these analyses does not invalidate the findings concerning fertility trends in urban and rural areas but rather indicates that the differential trends were probably even greater than reported here.

Most of the effects of proximate determinants were straightforward and consistent with those found in previous studies, even though these studies used different methods (Harwood-Lejeune, 2000; Gobopamang and Letamo, 2001). This investigation revealed the roles of infertility and religion in the fertility increase in sub-Saharan Africa, as well as the roles of contraceptive use, age at marriage, and urbanization in the fertility decline.

Modern education appears to have played a different role in this longitudinal investigation than in cross-sectional studies. This is not surprising because the two approaches focus on different aspects (determinants versus differentials), and modern education is primarily a critical factor of differentials rather than of trends, as is also true for mortality studies. This highlights the fact that fertility decline can occur in areas with low levels of education and that no minimum education level is necessary for fertility decline; this has been shown repeatedly throughout the world (van de Walle and Knodel, 1980).

The role of urbanization is equally complex. For sub-Saharan Africa as a whole, urbanization appears to be a structural factor because social change is more rapid in urban areas than rural areas. Urban residence is also associated with higher education and income levels and a variety of other factors that have some relation to fertility. Very rural countries, such as Kenya, underwent some of the most striking fertility transitions, and the urbanization stall in South Africa from 1960 to 1994 did not hamper its rapid fertility decline. In these countries, successful family planning programs and, to a lesser extent, increases in age at first marriage could explain their fertility declines. These observations are compatible with a detailed analysis of the European fertility transition that also showed virtually no relationship between fertility decline and urbanization or socioeconomic indicators (van de Walle and Knodel, 1980).

The relationship between family planning programs and fertility decline is difficult to describe because of its mechanical nature (Mbacke, 1994). The statistical relationship between contraceptive use and TFRs is straightforward and basically linear; numerous authors have described this relationship (Rutenberg, 1991; Leridon and Toulemon, 1996; Garenne and Joseph, 2002). What remains to be analyzed is the speed of the fertility decline as a function of the efforts to provide all women with efficient, safe, and affordable contraception after controlling for potential confounders, such as age at marriage. Such an analysis would require another study and both quantitative and qualitative data on family planning programs. Regardless, this study provides confirmation that contraceptive use is the leading driver of the fertility decline in sub-Saharan Africa. The fertility decline appears to be primarily a consequence of the different reproductive health programs and policies of countries in this region.

A single, precise definition of the onset of the fertility transition is difficult to develop. If one focuses on the split between urban and rural trends, one often finds that the fertility decline began earlier than if one considers the steady decline in urban areas, the decline in the country as a whole, or the decline in rural areas. Considering the split between period and cohort fertility, which some authors have chosen, could also give a different onset date. Using the 10 percent threshold below the peak fertility, as is common in historical demography, would be misleading in the case of sub-Saharan Africa. Regardless of the definition selected for the onset of the fertility transition, the important issue is the magnitude and speed of the fertility changes in sub-Saharan Africa, which have somehow been hidden in broad international comparisons of fertility levels and certainly do not match economic development indicators and trends.

Some authors have emphasized the impact of differences among regions (eastern versus western or southern Africa) or colonial cultures (Anglophone, Francophone, and Lusophone areas) on fertility decline. Some patterns are emerging, but differences between countries are much larger than among regions or cultures. For example, the fertility declines in the urban areas of Senegal, Burkina-Faso, Togo, and Mozambique were as large as in the countries with the most rapid fertility declines (such as Botswana and Zimbabwe). In contrast, the fertility decline in rural Uganda was as slow as in some of the Francophone Sahelian countries. Furthermore, the fertility decline in the urban areas of countries that were not affected by colonization, such as Ethiopia, was even more rapid than elsewhere.

The fertility transition, a path from peak fertility to replacement fertility levels, is well advanced in sub-Saharan Africa. Approximately 60 percent of the transition was completed in urban areas within about 30 to 40 years, and approximately 22 percent of the transition was completed in rural areas within approximately 20 to 30 years. These trends are likely to continue in the future, even though minor fertility stalls occur periodically. These stalls rarely last very long, at least based on previous experiences in Africa or Latin America. Several regions in sub-Saharan Africa, especially urban areas, have almost achieved replacement fertility levels; a few rural areas are also approaching replacement fertility levels (Garenne et al., 2007; Shemeikka et al., 2005).

No one knows what future course the transition will take, but it is possible that even lower levels, below replacement fertility, could be achieved in the near future. This has already occurred in large cities in South Africa and Ethiopia. Whether the fertility decline becomes "endless," as some authors have suggested, remains to be seen (Basu, 2007).

Many aspects of the fertility decline in sub-Saharan Africa remain to be analyzed, such as differences by country, residence area, and possibly region or ethnicity. Even though all sub-Saharan African countries appear to be undergoing a fertility decline, the fertility dynamics and their impact are often different in different regions. Further research on these differences could shed new light on the ultimate determinants of fertility changes in sub-Saharan Africa and the potential future of fertility levels in the region.

Appendix A

Table A.1 List of WFS and DHS surveys analyzed, sub-Saharan Africa

Country	WFS	DHS-I	DHS-II	DHS-III	DHS-IV
Benin	1982			1996	2001
Botswana		1988			
Burkina Faso			1993	1999	2003
Burundi		1987			
Cameroon	1978	1991		1998	2004
Central African Republic				1994	
Chad				1996	2004
Comoro Islands				1996	
Congo					2005
Côte d'Ivoire	1980			1994	1999
Ethiopia				2000	2005
Gabon				2000	
Ghana	1979	1988	1993	1999	2003
Guinea			1992	1999	2005
Kenya	1978	1989	1993	1998	2003
Lesotho	1977				2004
Liberia		1986			
Madagascar			1992	1997	2003
Malawi			1992	2000	2004
Mali		1987		1996	2001
Mozambique				1997	2003
Namibia			1992		2000
Niger			1992	1997	
Nigeria	1982	1990		1999	2003
Rwanda	1983		1992	2000	2005
Senegal	1978	1986	1993	1997	2005
South Africa[a]				1998	
Sudan	1979	1989			
Tanzania		1991	1996	1999	2004
Togo		1988		1998	
Uganda		1988		1995	2001
Zambia			1992	1996	2001
Zimbabwe		1988	1994	1999	

WFS = World Fertility Survey
DHS = Demographic and Health Surveys.
[a]Data from surveys in South Africa were not used for the country analysis of fertility trends but were integrated into the analysis of fertility determinants.

Table A.2 List of censuses and demographic surveys (other than WFS and DHS surveys) analyzed, sub-Saharan Africa

Country	Demographic surveys	Censuses
Benin	1960-61	1992
Botswana	1984 1991	1971 1981
Burkina Faso	1961 1991	1975 1985
Burundi	1965 1970-1971	
Cameroon	1965	
Central African Republic	1959-60	1975 1988
Chad	1964	
Comoro Islands		1958 1966 1991
Congo	1961	1984
Côte d'Ivoire	1962-1964 1978-1979	1988
Ethiopia	1990 1998	1984 1994
Gabon	1961	1993
Ghana	1971	1948 1960
Guinea	1955	1983 1996
Kenya	1977 1984	1962 1969 1979
Lesotho	2001	1976 1986 1996
Liberia	1971	1974
Madagascar	1966 1980	1975
Malawi	1982 1984 1996	1977 1987 1998
Mali	1957	1987
Mozambique		1950 1981 1997
Namibia		1981 1991 2001
Niger	1960 1963	1988
Nigeria	1965-1966 1994	
Rwanda	1970	1978 1990
Senegal	1957 1960 1979	
Tanzania		1967 1978 1988
Togo	1961	1971 1981
Uganda		1959 1969 1991
Zambia		1969 1980 1990
Zimbabwe		1969 1992

Appendix B

This appendix presents reconstructed fertility trends for 31 sub-Saharan African countries over the 1950-2000 period. The reconstruction focuses on period fertility and uses cohort fertility as an independent check and to reconstruct period fertility trends from 1950 to the first year covered by World Fertility Surveys (WFS) and Demographic and Health Surveys (DHS) surveys.

Throughout this appendix, cohort analyses are based on year of birth 30 years before the 1950-2000 period, i.e., 1920-1970. When earlier or later data are available, they are also mentioned.

The relationship between period and cohort fertility trends is explained in the methods section of the report, where the somewhat different dynamics of these two indicators are discussed. Because of these dynamics, the period estimates are often higher than the cohort estimates during periods of rising fertility and, conversely, the period estimates are often lower than the cohort estimates during periods of declining fertility. The trend estimates end at the last year for which data are available from the WFS and DHS surveys.

The period and cohort fertility trends are presented for each sub-Saharan African country in the analysis as a whole, and separately for urban and rural areas and for premarital and marital fertility.

Calculating Period Fertility Rates

The total fertility rate (TFR) considered here refers to cumulative fertility by age 40 [TFR(40)]. TFR(40) is the sum of age-specific fertility rates [f(a)] below age 40. The age-specific fertility rate is the ratio of births by age [B(a)] to the number of person-years lived at that age [N(a)]. Age-specific fertility rates from age 12 to 40 were added up from DHS and WFS data for each calendar year.

$$TFR(40) = \int_{a=12}^{40} f(a)da = \sum_{a=12}^{39} \frac{B(a)}{N(a)}$$

The person-years and births were calculated for the age groups 12-14, 15-19, 20-24, 25-29, 30-34 and 35-39, and for one-year periods. When several surveys covered the same period, the numerators and denominators were added from each survey for the same country.

For convenience and to minimize random fluctuations, the figures in this appendix display results by two-year period (or three-year period when the sample size is small). In this case, the results for TFR(40) were calculated by adding the numerators and denominators for all years within a given time period.

The results for TFR(40) were compared with published data from other surveys and censuses on period fertility. The censuses and other surveys used usually collected information on period fertility by asking respondents about births in the past 12 months. Five-year fertility rates were computed, usually for groups age 15-19 to 35-39, and occasionally starting at age 10-14 or 12-14.

Calculating Cohort Fertility Rates

Cohort fertility estimates were compared to period estimates.

For demographic surveys (other than DHS or WFS surveys) and censuses that only reported data by 5-year age group, the number of children ever born by age 40 [CEB(40)] was calculated as the average completed family size in age groups 35-39 and 40-44. For women older than 50, the mean number of

children ever born was converted into CEB(40) by applying a constant coefficient of 0.90 (90 percent of total fertility occurs before age 40 in DHS survey results from sub-Saharan Africa). This made it possible to use census data on older women, primarily those in the 50-59, 60-69, and 70-79 age groups. These values were applied to corresponding periods of 25, 35, and 45 years before the survey.

Because a woman's average age at first birth is almost 30 years in sub-Saharan Africa, the cohort fertility estimates were matched with period estimates 30 years after the year of the mother's birth. For example, for women born in 1930, the completed family size at age 40 was matched with the period fertility rate in 1960.

The period corresponding to the cohort estimates is referred to as the "reference period" in all of the tables in this appendix.

Fertility Trends in Urban and Rural Areas

TFR(40,t), or the cumulated fertility by age 40 by calendar year (t), was calculated. Time trends were fitted using a linear regression on each year by ordinary least square (OLS). For this procedure, the TFR(40,t), calculated from B(40,t) births, was considered to be equivalent to the completed family sized (CFS) of a cohort of N=B/TFR women with the same TFR and the same number of births.

To estimate the standard deviations of the estimates, the births were distributed by parity and a synthetic cohort of women was constructed. The distribution of births was calculated by parity for each country and each year by fitting a logit linear relationship between proportion of birth order and TFR(40) using cohort data from birth order 0 to 16+. A small adjustment was made to ensure that the sum of the proportions equaled 1, so that the reconstructed mean CFS equaled the observed TFR(40). The main advantages of this procedure were that it provided standard errors for estimates, made it possible to test differences in slopes using classic T-tests, and made possible direct comparisons with trends in cohort fertility.

Next, the regression line was fitted directly from the reconstructed data using an OLS model:

$$TFR(40,t) = A + B * t$$

where TFR(40,t) is the cumulated fertility by age 40 at time (t), t is the calendar year, and A and B are two constant coefficients.

When the slope for TFR(40) changed from positive to negative, from no slope to negative, or from negative to nil (fertility stall), the change in slope was tested using the same T-test. Trends between 1950 and the first year for which survey data were available were derived from the same equation by extrapolating the data backward in time. Trends for urban areas were cut at the point at which they intersected the national average. Before the intersection point, TFR(40,t) was assumed not to differ between urban and rural areas; the data appear to support this assumption in most of the countries for which information is available.

Premarital and Marital Fertility

The proportion of premarital births is defined as the ratio of the number of premarital births before age 40 to the total number of births before age 40.

$$\Pr op_{prem}(t) = \frac{\int_{a=12}^{40} B_{prem}(a)da}{\int_{a=12}^{40} B(a)da}$$

These trends in premarital and marital fertility were estimated by fitting a logit-linear relationship of the proportion of premarital births by calendar year using WFS and DHS survey data.

$$Logit(\Pr op_{prem}(t)) = A + B \times t$$

The proportion of premarital births was applied to the reconstructed trends in total fertility. Total fertility is therefore the sum of the premarital and marital fertility rates, which is different from the sum of age-specific marital fertility rates used in historical demography to calculate classic estimates of total marital fertility.

$$TFR_{prem}(40,t) = TFR(40,t) \times \Pr op_{prem}(t)$$

and

$$TFR(40) = TFR_{prem}(40,t) + TFR_{marital}(40,t)$$

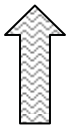
Throughout this appendix, all references to "premarital fertility level" pertain to TFR(40) in never-married women at the time of the child's birth.

Presentation

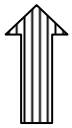
Essentially the same types of information are presented for each sub-Saharan African country case study: data available from DHS, WFS, and other demographic surveys and censuses; a table with estimates of cohort and period fertility levels in different years and age groups based on data from sources other than WFS and DHS surveys; a brief comment on trends, with special reference to urban and rural areas and marital and premarital fertility; and two figures showing trends for rural versus urban fertility and premarital versus marital fertility.

For each country considered, the first figure displays the reconstructed period fertility trends for urban and rural areas separately using WFS and DHS survey data and additional information on fertility levels, when available, such as data from censuses and other surveys (surveys other than DHS or WFS) on period and cohort fertility. The figures also display the trends estimated by regression for the period covered by the surveys and the extrapolation from 1950 to the earliest point for which survey data are available, based either on later trends or on cohort estimates of CFS.

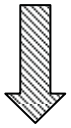
Arrows display the time points at which major changes occurred, such as changes in slope from nil or positive to negative for urban and rural areas, or divergent trends between urban and rural areas. The arrows have different patterns, defined as follows:



Split between urban and rural areas



Decline in urban areas



Decline in rural areas

All data in the first figures for each country come from DHS and WFS survey results, unless otherwise specified. When the figures display data from sources other than WFS and DHS surveys, these data apply to the entire country and generally represent a midway point between urban and rural areas estimates, depending on the proportion of urban residents in the country. The data points labeled "published" are published values from DHS reports and are shown separately for urban and rural areas.

The second figure for each country displays the trends in premarital and marital fertility. Premarital births are defined as births occurring before a woman's first marriage or to women who had never been married at the time of the survey. Conversely, marital births are births that occur after the mother's first marriage.

The case studies are presented in alphabetical order by country name. No attempt was made to discuss in depth the quality of the data from sources other than the WFS and DHS. The focus was on the main patterns of fertility trends.

Benin

Benin conducted a WFS survey in 1982 and DHS surveys in 1996 and 2001. The fertility trends were similar in the three surveys. The 1982 WFS survey covered 1967-1982, when fertility rates were rising slowly, with an average TFR(40) of 6.48. The 1996 DHS survey covered 1981-1996, which could be divided into two parts. In the first part, fertility was somewhat higher than in the 1982 WFS survey, and the second part showed declining fertility trends, with peak fertility occurring in 1985-1986. The 2001 DHS survey covered 1986-2001 and indicated declining fertility trends, with levels and slopes compatible with those of the 1996 DHS survey for the overlapping period (1986-1996).

A demographic sample survey in 1960-1961 (the Dahomey survey) estimated TFR(40) in Benin to be 6.30 in 1961. CFS was 5.37 in approximately 1951 (women age 35-44 in 1960-1961 had given birth 10 years earlier, on average). Estimates of CFS for women age 50-59 (5.18) and 60 years and above (5.38) in 1960-1961, which pertained to births that had occurred approximately 15 to 25 years earlier (between 1936 and 1926), were basically identical. The similarity of CFS rates for older women indicates that fertility was stable, at approximately 5.2, prior to 1951; this rate corresponds to a TFR(50) of 5.7 (Table B.1).

Table B.1 Estimated fertility levels, Benin, 1926-1991

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1960-61	CEB (60+)	1926.5	5.38	5.98
Survey, 1960-61	CEB (50-59)	1936.5	5.18	5.75
Survey, 1960-61	CEB (35-44)	1951.5	5.37	5.77
Census, 1992	CEB (70-79)	1947.1	4.82	5.35
Census, 1992	CEB (60-69)	1957.1	5.06	5.63
Census, 1992	CEB (50-59)	1967.1	5.29	5.88
Census, 1992	CEB (35-44)	1982.1	5.48	5.92
Period fertility				
Survey, 1960-61	TFR (40)	1961.0	6.30	6.86
Census, 1992	TFR (40)	1991.6	5.65	6.14

The combined estimates from the three DHS and WFS surveys showed an increasing fertility level from a TFR(40) of 5.88 in 1967 to a peak of 6.72 in 1986, followed by a declining level to 5.05 in 2001; both slopes were highly significant ($p < 0.0001$). The evidence therefore clearly shows that fertility rose in Benin before 1986 and declined rapidly thereafter.

The trend obtained by extrapolating the WFS and DHS survey data backward to 1951 yielded a TFR(40), 5.16, close to that observed, 5.37. What occurred between 1951 and 1967 remains unclear; it is possible that fertility rose more rapidly between 1951 and 1961 and less rapidly thereafter.

Period fertility trends in urban and rural areas differed markedly (Figure B.1.1). TFR(40) in urban areas seems to have remained stable, at approximately 5.72, between 1967 and 1986, then declined thereafter to reach 3.89 in 2001. In contrast, period fertility increased in rural areas from 5.99 in 1967 to 7.22 in 1989 before declining to 5.70 in 2001. The split in trends between urban and rural areas seems to have occurred in approximately 1960 and became pronounced in the early 1980s. The declining fertility trends after 1989 were similar in urban and rural areas (slopes of -0.131 in urban areas and -0.133 in rural areas, $p = 0.955$).

The 1992 census data yielded estimates of TFR(40) that were approximately 10 percent lower than estimates based on DHS survey data for the same period (1960-1990), although differences between urban and rural areas based on the census and DHS survey data were consistent. However, estimates of CFS for earlier periods (prior to 1960) were more consistent with other estimates.

The increase in fertility rates from 1951 to 1989, which was most obvious in rural areas, can be explained by declining infertility rates. For example, the 1992 census shows that, based on primary infertility rates (number of women who never had any live birth) by cohort, the proportion of infertile women declined from 12.3 percent for women age 75+ in 1992 (born around 1915) to 4.9 percent for women age 35-39 in 1992 (born in approximately 1955).

Premarital fertility had a low prevalence in Benin over the period considered and showed a declining trend (slope = -0.024, $p < 0.001$) (Figure B.1.2).

Figure B.1.1 Trends in Cumulated Fertility by Age 40, Benin, 1950-2001

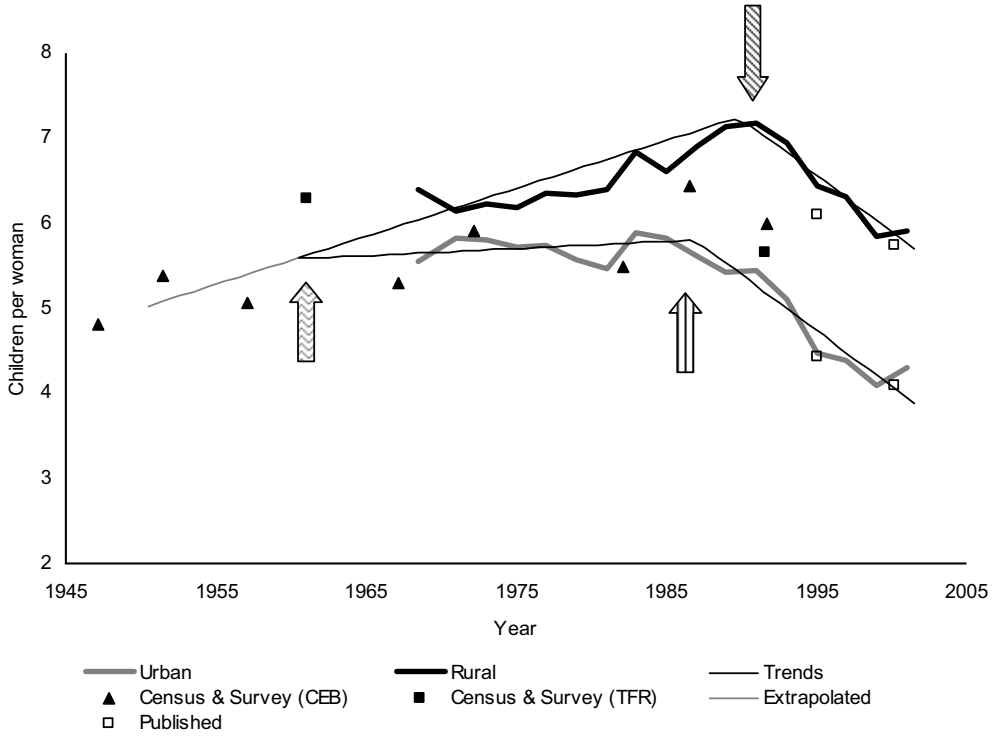
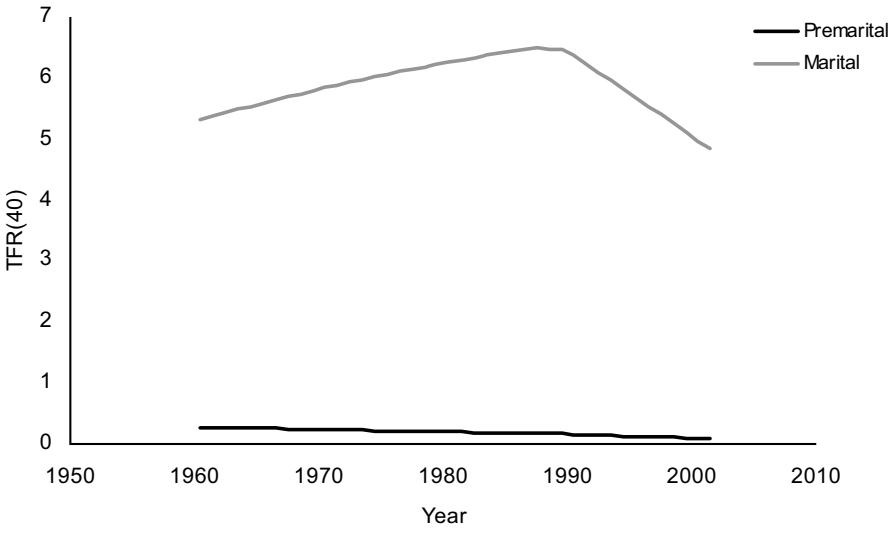


Figure B.1.2 Trends in Marital and Premarital Fertility, Benin, 1960-2001



Botswana

Botswana has conducted only one DHS survey, in 1988, covering 1973-1988. These data indicate that fertility had a rapidly declining trend (slope of -.108, $p < 0.0001$). The survey had a small sample and this analysis included only 8,831 births; as a result, yearly estimates fluctuate widely.

Censuses in 1971, 1981, and 1991 and a demographic survey (Botswana Family Health Survey, 1984) provide additional evidence on fertility trends in Botswana in the 20th century. Data from the 1981 and the 1991 censuses and the 1984 demographic survey cover a broad period and their data on fertility levels, but not trends, are consistent with the DHS data. Unlike the DHS data, the census data show that fertility trends were increasing or erratic during the study period. Data prior to 1950 are consistent and indicate that TFR(40) was stable at 4.7 [TFR(50) of 5.3]. Fertility increased in the 1950s and 1960s, reaching a level of approximately 6.0 by 1973, the time of the earliest DHS data. However, TFR(40) levels from the 1971 census data are lower than the expected levels, suggesting that the data quality is poor or the 1971 value was erratic. In contrast, the TFR(40) from the Botswana Family Health Survey is higher than expected, suggesting a possible selection bias in the sample.

Table B.2 Estimated fertility levels, Botswana, 1926-1984

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1971	CEB(70-79)	1926.7	4.65	5.17
Census, 1971	CEB(60-69)	1936.7	4.60	5.11
Census, 1971	CEB(50-59)	1946.7	4.72	5.25
Census, 1971	CEB(40)	1961.7	5.32	5.57
Census, 1981	CEB(60-69)	1946.6	4.47	4.97
Census, 1981	CEB(50-59)	1956.6	4.89	5.44
Census, 1981	CEB(40)	1971.6	5.26	5.66
Survey, 1984	CEB(40)	1974.5	5.82	6.84
Census, 1991	CEB(60-69)	1956.6	5.26	5.84
Census, 1991	CEB(50-59)	1966.6	5.75	6.39
Census, 1991	CEB(40)	1981.6	5.12	6.09
Period fertility				
Census, 1971	TFR(40)	1971.2	4.85	5.79
Census, 1981	TFR(40)	1981.1	5.13	6.22
Survey, 1984	TFR(40)	1984.0	5.48	6.46

When the trends estimated from the 1988 DHS survey are extrapolated beyond 1988, the predicted TFR(40) is 2.99 in 2001. This figure is almost identical to the value from the 2001 census (2.94), a good indication of the accuracy of the reconstruction.

In their comprehensive analysis of fertility trends in Botswana, Rutenberg and Diamond (1993) concluded that fertility had declined rapidly since 1981 and previous fertility levels had been overestimated. The reconstruction of fertility trends is essentially consistent with the estimates of Rutenberg and Diamond (1993).

Trends in urban and rural areas were parallel in the DHS survey results, and the difference between the two slopes was not significant ($p = 0.767$) (Figure B.2.1). The precise timing of the onset of the fertility transition in Botswana is therefore difficult to delineate. Because TFR(40) has apparently never exceeded 6.0, the fertility transition seems to have begun in approximately 1968 in urban areas and approximately 1973 in rural areas.

Botswana and its western and southern neighbors have some of the highest rates of premarital fertility in Africa. The proportion of premarital births increased from 34 percent in 1963 to 43 percent in 1988. As a result, the premarital fertility level remained essentially constant over time, at an average of approximately 2.0 children per women. In contrast, marital fertility appears to have declined rapidly from 3.98 in 1973 to 2.52 in 1988 (Figure B.2.2).

Figure B.2.1 Trends in Cumulated Fertility by Age 40, Botswana, 1950-1988

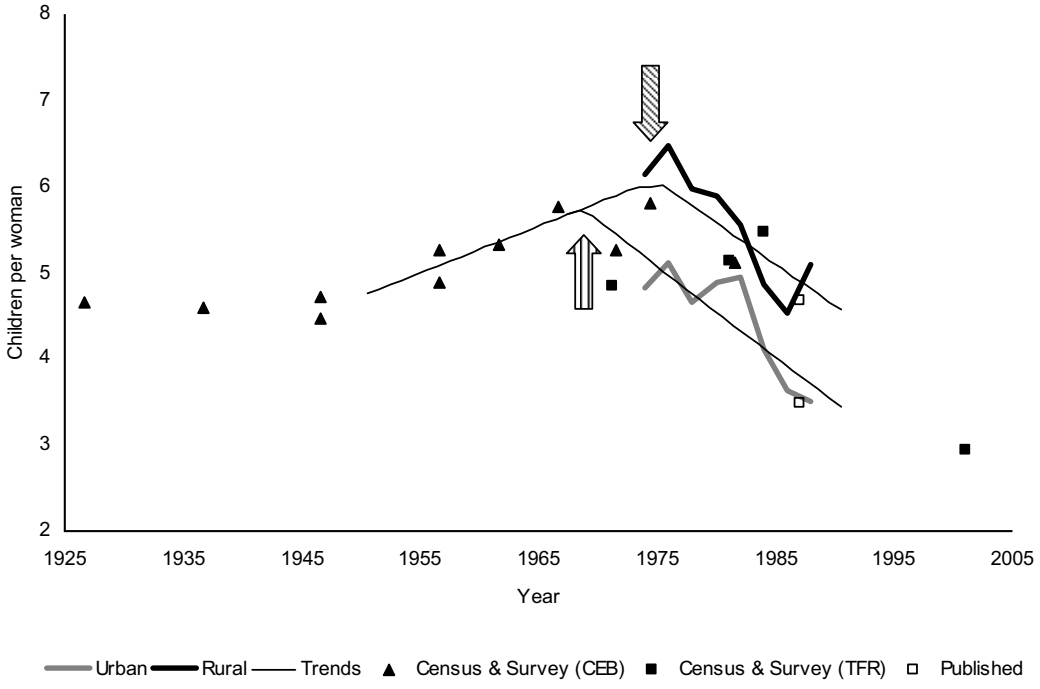
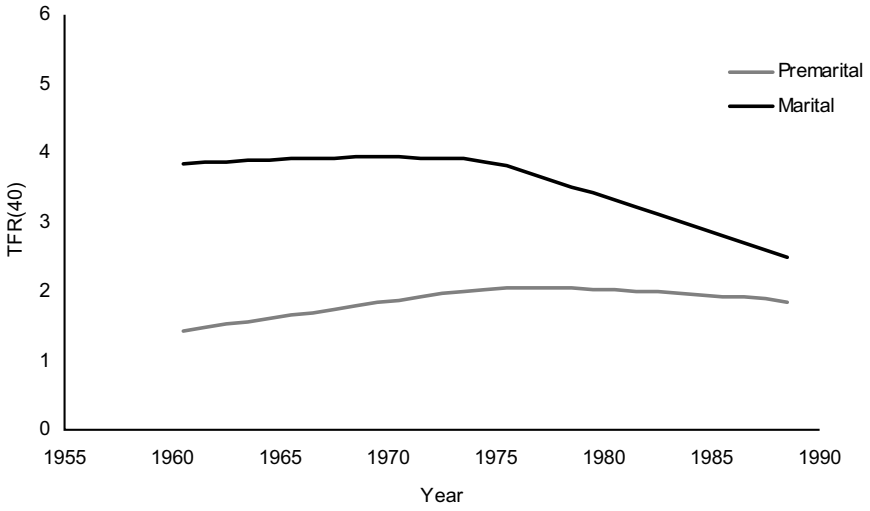


Figure B.2.2 Trends in Marital and Premarital Fertility, Botswana, 1960-1988



Burkina Faso

Burkina-Faso conducted DHS surveys in 1993, 1999 and 2003; these surveys covered 1978-2003. All three surveys had similar results for fertility levels and showed declining trends in the 15 years preceding the survey.

Burkina-Faso, formerly known as Upper Volta or Haute-Volta, conducted demographic sample surveys in 1961 and 1991 and censuses in 1975 and 1985 (Table B.3). The census and survey data indicate that TFR(40) was probably very stable, at approximately 4.9, prior to 1950. By 1961, period fertility by age 40 was already higher (5.52), and it continued to increase until 1980.

Table B.3 Estimated fertility levels, Burkina-Faso, 1916-1991

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1961	CEB(70+)	1916.0	4.85	5.39
Survey, 1961	CEB(60-69)	1926.0	4.97	5.53
Survey, 1961	CEB(50-59)	1936.0	4.88	5.43
Survey, 1961	CEB(40)	1951.0	5.03	5.40
Census, 1985	CEB(70-79)	1941.0	4.44	4.93
Census, 1985	CEB(60-69	1951.0	4.78	5.32
Census, 1985	CEB(50-59)	1961.0	5.32	5.91
Census, 1985	CEB(40)	1976.0	5.84	6.31
Survey, 1991	CEB40)	1981.5	6.29	6.87
Period fertility				
Survey, 1961	TFR(40)	1960.5	5.52	6.05
Census, 1975	TFR(40)	1975.4	6.03	6.70
Census, 1985	TFR(40)	1985.5	6.47	7.18
Survey, 1991	TFR(40)	1991.0	6.48	7.31

Period fertility trends in urban and rural areas were markedly different. In urban areas, TFR(40) declined from 6.97 in 1978, the first year covered by the DHS surveys, to 3.08 in 2003. In rural areas, period fertility levels increased from 7.27 in 1978 to 7.40 in 1986, when they started to decline, reaching 6.08 in 2003. The change in slopes was highly significant ($p < 0.0001$). The intersection between urban and rural fertility trends occurred in 1977, the year of onset of the fertility transition in Burkina Faso.

When the increasing trend was extrapolated backward, the period fertility level was estimated to be 5.44 in 1951 and 6.12 in 1961. The resulting trend was consistent with, but somewhat higher than, trends from other surveys. Fertility levels were clearly increasing in rural areas from 1951 to 1986 in Burkina Faso before decreasing.

The proportion of premarital births remains small in Burkina Faso, with an average rate of 1.7 percent, and has had no significant trend ($p = 0.155$).

Figure B.3.1 Trends in Cumulated Fertility by Age 40, Burkina-Faso, 1950-2003

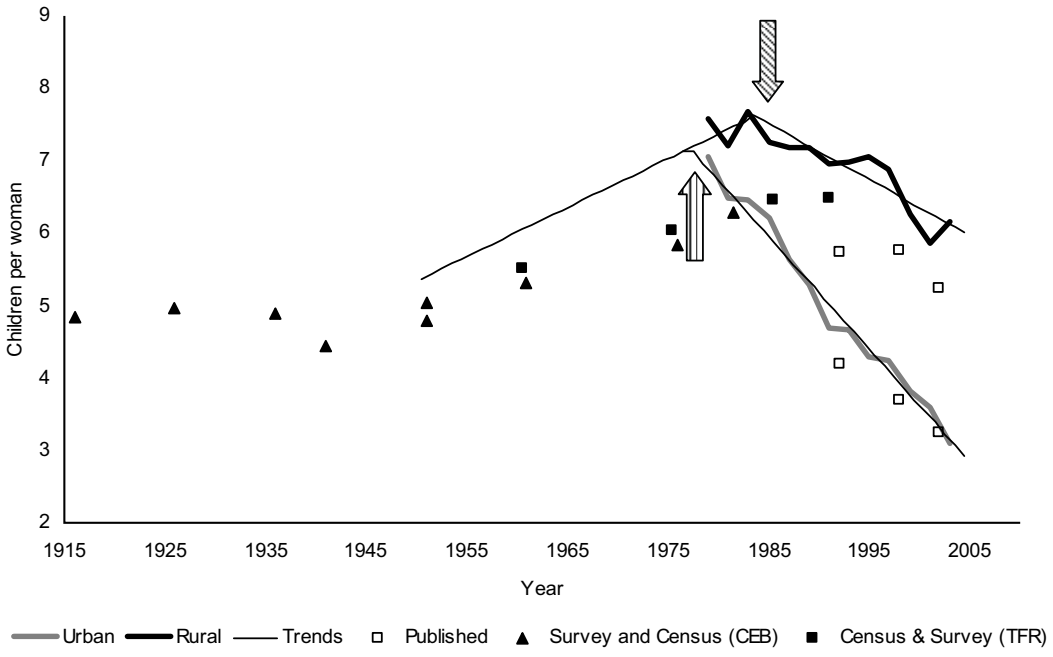
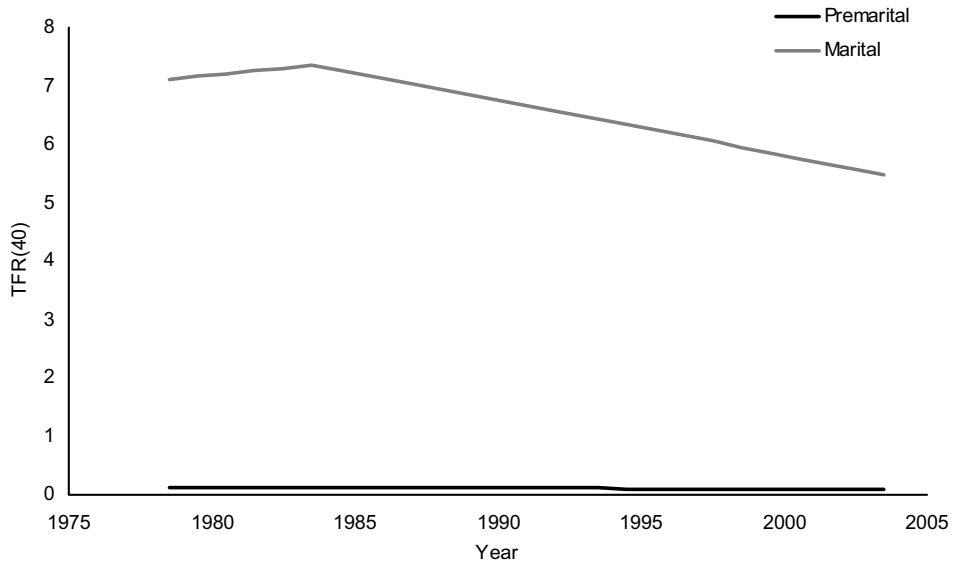


Figure B.3.2 Trends in Marital and Premarital Fertility, Burkina-Faso, 1978-2003



Burundi

Burundi conducted only one DHS survey, in 1986, that covered 1971-1986. The survey collected data on only 9,408 births, including just 326 births in urban areas.

Two demographic surveys were conducted in Burundi in 1965 and 1970-1971. These surveys provide additional evidence on the onset of the country's fertility transition (Table B.4). According to the results of these demographic surveys, cohort fertility levels were probably stable at approximately 5.4 between 1935 and 1965 and increased slightly between 1960 and 1970, when the rate was 6.2. The period fertility rate changed only a little during the years covered by the DHS survey.

Table B.4 Estimated fertility levels, Burundi, 1935-1970

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1970-71	CEB (60+)	1935.9	5.35	5.94
Survey, 1970-71	CEB (50-59)	1945.9	5.40	6.00
Survey, 1970-71	CEB (35-44)	1960.9	5.51	5.92
Period fertility				
Survey, 1965	TFR (40)	1964.9	5.89	7.43
Survey, 1970-71 (retrospective)	TFR (40)	1969.9	5.08	5.67
Survey, 1970-71 (prospective)	TFR (40)	1970.9	5.25	5.90

Retrospective and prospective estimated fertility levels from the 1970-1971 survey results are lower than the reconstructed levels, whereas the levels for completed family size based on the 1970-1971 survey results were consistent with the reconstructed levels. The differences in fertility trend estimates might be due to defective data or the effects of civil unrest marked by ethnic strife in 1970-1972.

Trends in urban and rural fertility differed. Period fertility rates reached a plateau at approximately 6.24 in rural areas and declined in urban areas to 4.48 in 1987. Urban and rural trends began to diverge in 1970, which can be considered the turning point for the fertility changes in Burundi. Because the country was primarily rural over the period, national trends were similar to those of rural areas.

As in neighboring Rwanda, the proportion of premarital births had a very low prevalence rate (1 percent) over the period covered by the DHS survey in Burundi and did not change significantly ($p = 0.239$).

Figure B.4.1 Trends in Cumulated Fertility by Age 40, Burundi, 1950-1987

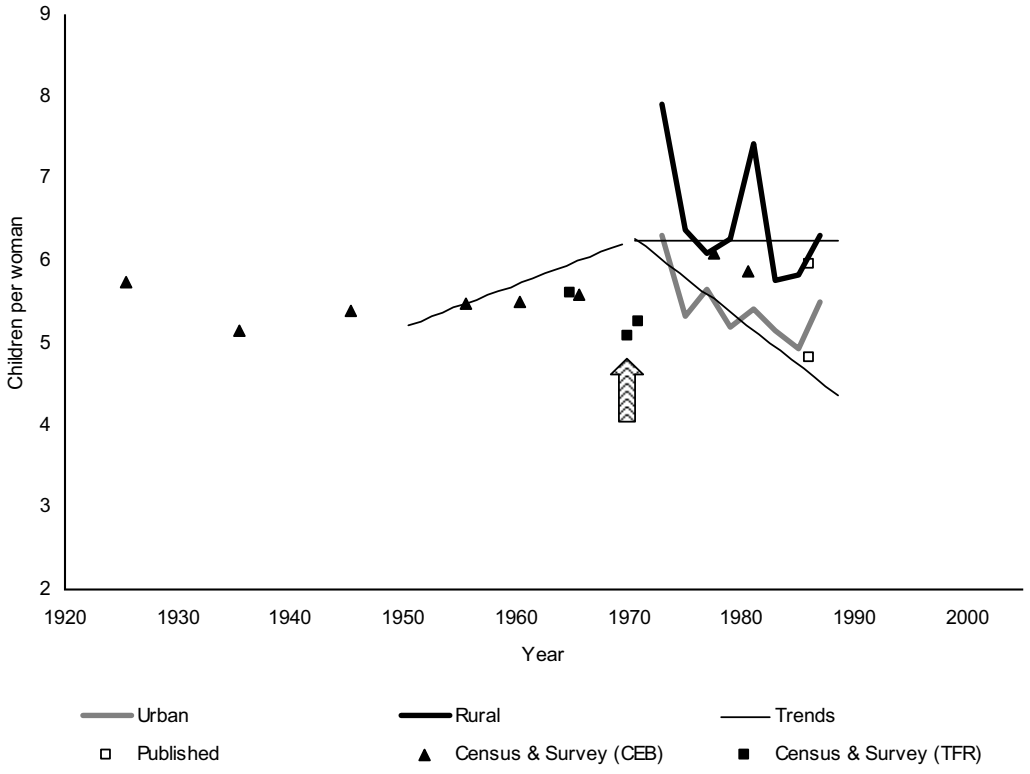
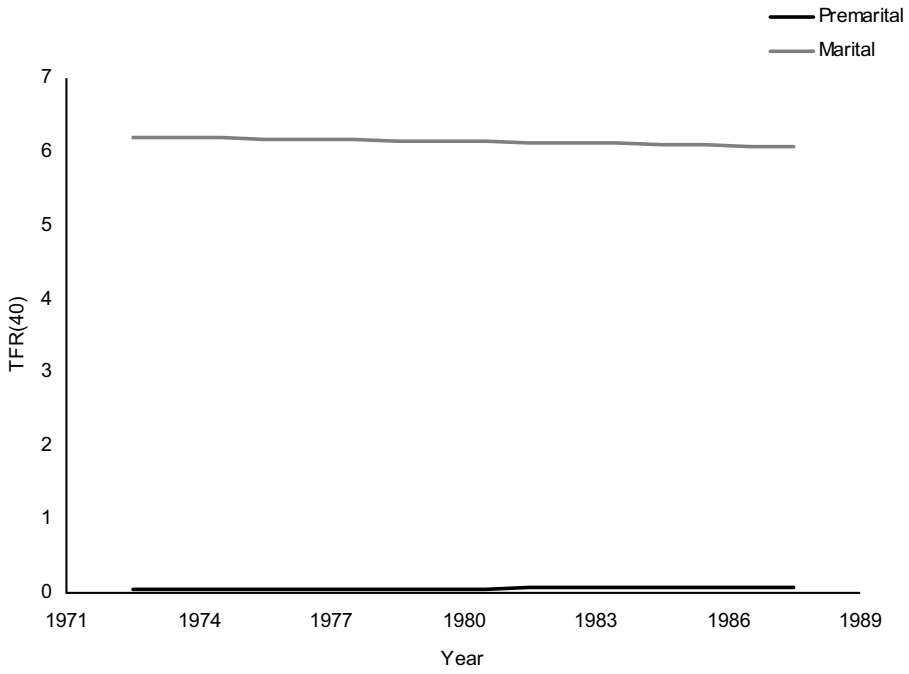


Figure B.4.2 Trends in Marital and Premarital Fertility, Burundi, 1972-1987



Cameroon

Cameroon conducted a WFS survey in 1978 and DHS surveys in 1991, 1998, and 2004, which covered 1963 to 2004. The fertility levels and trends from the results of all four surveys are essentially similar, except for some minor discrepancies. For example, the fertility levels were lower in 1995-1997 in the 1998 survey results than the 2004 survey. The 1978 WFS survey results indicated that the fertility rate had been rising since 1964, the 1991 DHS survey showed a plateau followed by a minor decline after 1980, and the 1998 and 2004 DHS surveys showed that fertility had been declining during the 15 years prior to survey.

The reconstructed trend was very similar to the trends from the WFS and DHS surveys. The reconstructed data indicate a rise in period fertility from 5.06 in 1963 to 6.34 in 1983, followed by a steady decline to 4.65 in 2004.

Several other surveys were conducted in Cameroon's major geographical areas in the 1960s. Table B.5 displays the findings from some of these surveys.

Table B.5 Estimated fertility levels, Cameroon, 1955-1965

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Western Cameroon, 1965	CEB(40)	1955	5.14	
Period fertility				
Western Cameroon, 1965	TFR(40)	1965	5.35	5.62

Available data show that the period fertility level was moderate, around 5 children per women by age 40, in Cameroon prior to 1963. The rate tended to rise steadily until 1983 before starting to decline.

Trends in period fertility in urban and rural areas were remarkably similar prior to 1983, and the two slopes were identical ($p = 0.619$). The difference between fertility levels in urban and rural areas remained small, at 0.73, between 1963 and 1983. After 1983, levels changed markedly: urban areas underwent a rapid decline from 5.77 in 1983 to 3.54 in 2003, whereas fertility declined more slowly in rural areas, from 6.51 in 1983 to 5.92 in 2003. Changes in trends between 1963-1983 and 1983-2003 were highly significant in both urban and rural areas ($p < 0.0001$ for both rural and urban areas). The difference between the slopes for fertility trends in urban and rural areas after 1983 was also highly significant ($p < 0.0001$).

No major trend was found in premarital fertility rates over the period covered by the DHS and WFS surveys. The proportion of premarital births was 6 percent, on average, throughout the period. The proportion was slightly higher between 1963 and 1973, slightly lower between 1973 and 1983, and close to 6 percent thereafter. The small decline in the proportion of premarital births from 1963 to 1983 was probably due to the increase in fertility levels during this period. As a result, the premarital fertility level appears to have remained essentially constant over time in Cameroon.

Figure B.5.1 Trends in Cumulated Fertility by Age 40, Cameroon, 1950-2004

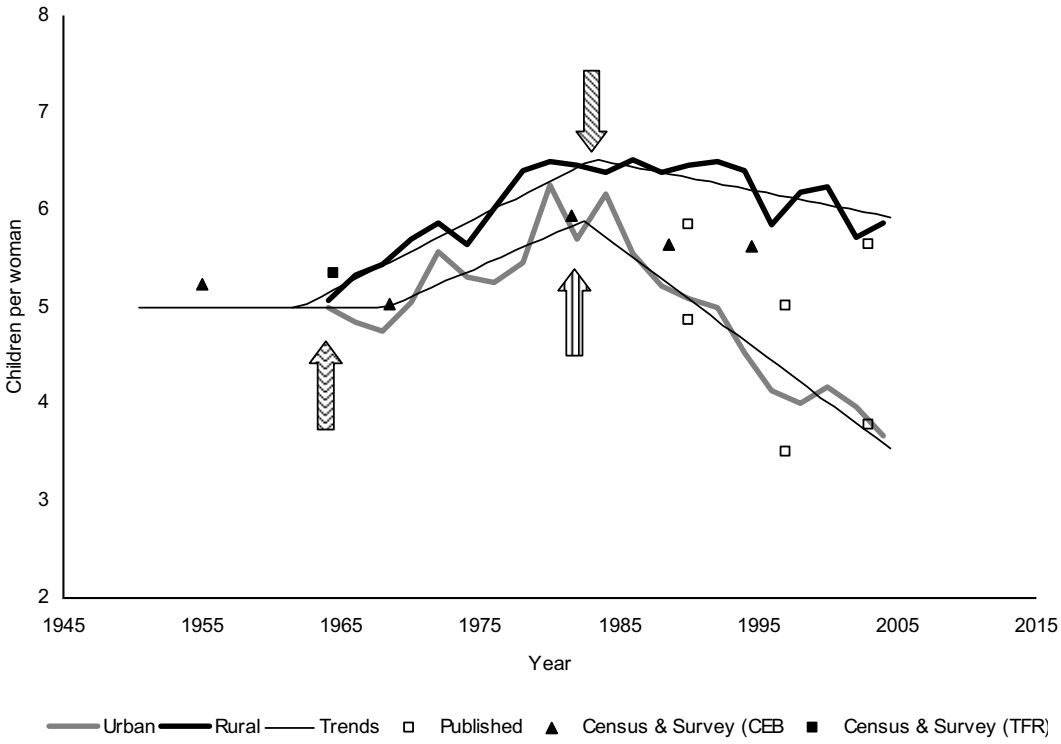
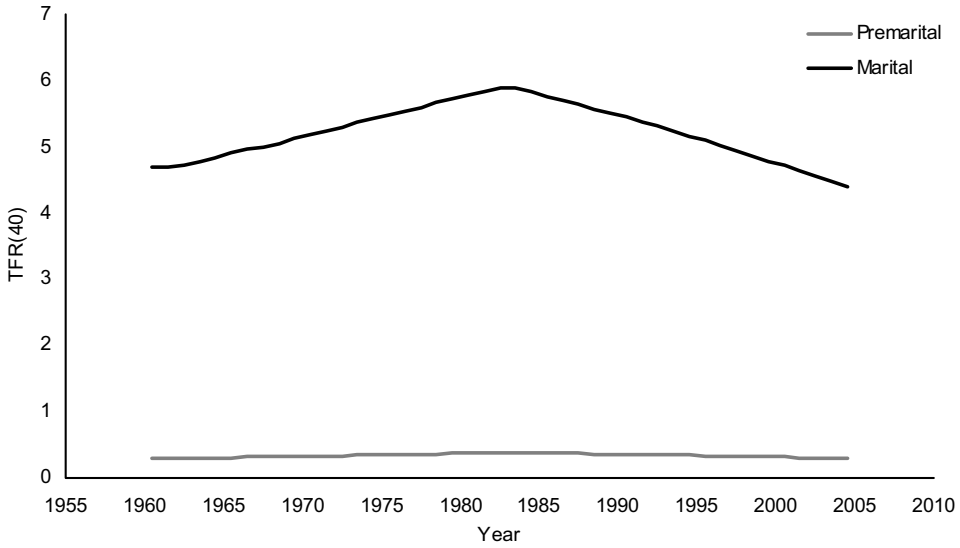


Figure B.5.2 Trends in Marital and Premarital Fertility, Cameroon, 1960-2004



Central African Republic

The Central African Republic conducted only one DHS survey, in 1994, covering 1980 to 1994. The survey indicated a rise in fertility levels from 1980 to 1988, followed by a steady decline.

A demographic survey was conducted in 1959-1960 in the Central African Republic, covering most of the country (about 86 percent of the population), except for the northeastern provinces. In addition, two censuses were conducted in 1975 and 1988. Data from these sources indicate that the Central African Republic's period fertility level was low, around 3.8, prior to 1950 and had probably been stable since at least 1925. Indeed, the 1959-1960 survey was one of the first to document very high rates of infertility in central Africa, where approximately 20 percent of women were sterile. The Central African Republic's infertility rate tended to diminish over time; for example, the 1988 census data showed that the proportion of women who never had a live birth was 18 percent for women age 50-59, 16.5 percent for women age 40-49, and 14 percent for women age 30-39.

Table B.6 Estimated fertility levels, Central African Republic, 1915-1978

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1959-60	CEB(40)	1950.0	3.64	4.06
Survey, 1959-60	CEB(50-59)	1935.0	3.74	4.16
Survey, 1959-60	CEB(60-69)	1925.0	3.87	4.30
Survey, 1959-60	CEB(70+)	1915.0	3.29	3.66
Census, 1975	CEB(40)	1965.9	4.53	4.70
Census, 1988	CEB(40)	1978.9	4.62	4.64
Period fertility				
Survey, 1959-60	TFR(40)	1959.5	4.74	4.93

The fertility trends in urban and rural areas in the Central African Republic had several unusual features (Figure B.6.1). First, the fertility rates and directions of the trends in urban and rural areas were similar. Second, trends in urban and rural fertility appear to have intersected in approximately 1986. Fertility levels in rural areas were lower, increased more rapidly, and started to decline slightly later than in urban areas. This can be explained by the fact that infertility was more prevalent in rural areas in the earlier years and, therefore, the decline in infertility presumably had a greater effect on fertility rates in these areas. However, in the results from both the 1960 survey and the 1988 census, fertility levels in urban areas were somewhat higher than in rural areas; further research is needed on this issue.

The proportion of premarital births was low, 3.0 percent, in 1980 but tended to increase rapidly thereafter, reaching an estimated prevalence of 8.4 percent in 1994. As a result, premarital fertility increased over the period covered by the DHS survey, despite the fertility decline after 1988 (Figure B.6.2).

Figure B.6.1 Trends in cumulated fertility by age 40, Central African Republic, 1950-1994

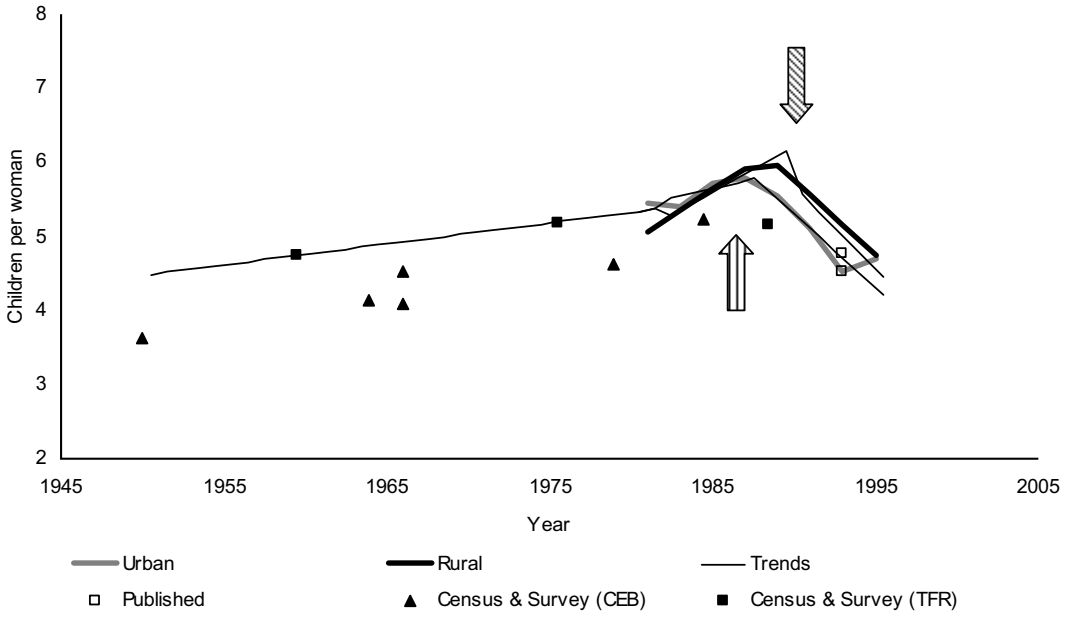
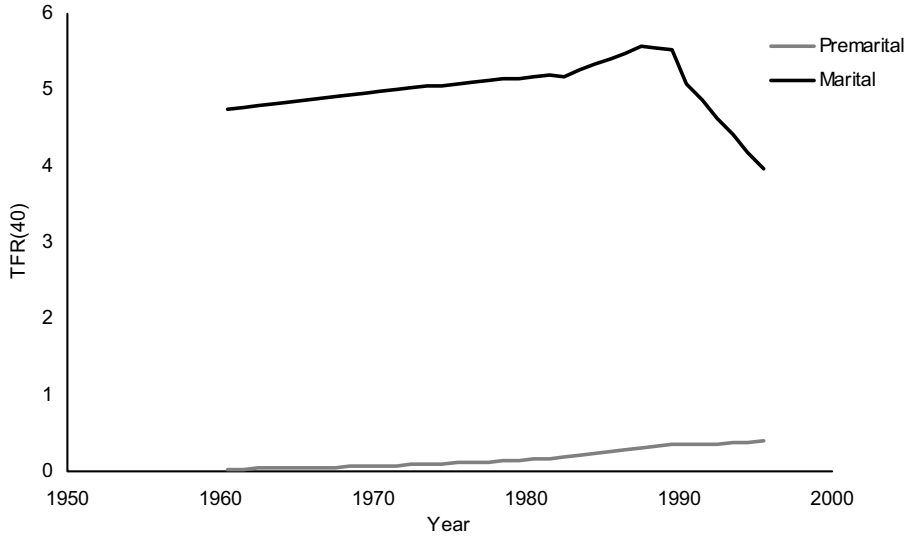


Figure B.6.2 Trends in Marital and Premarital Fertility, Central African Republic, 1960-1995



Chad

Chad conducted DHS surveys in 1997 and 2004 covering 1983 to 2004. The fertility levels and trends from the results of both surveys were similar. The 1997 survey indicated an increase in fertility followed by a slight decrease. The 2004 survey also showed that fertility increased and then decreased, and fertility levels from both surveys were similar in the overlapping period (1989-1997).

A survey conducted in Chad in 1964 provides detailed information on fertility in the first half of the 20th century (Table B.7). The results of this survey indicate that Chad's TFR(40) was low, around 4.0 [TFR(50) = 4.4], prior to 1950 and had changed little since 1920.

Table B.7 Estimated fertility levels, Chad, 1919-1963

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1964	CEB(70+)	1919.3	3.80	4.22
Survey, 1964	CEB(60-69)	1929.3	3.99	4.43
Survey, 1964	CEB(50-59)	1939.3	4.12	4.58
Survey, 1964	CEB(40)	1954.3	4.22	4.73
Period fertility				
Survey, 1964	TFR(40)	1963.8	4.64	5.13

The DHS survey results indicate that the period fertility rate was much higher by 1982, and trends in urban and rural areas diverged. In urban areas, the fertility rate appears to have declined steadily over the period covered by the DHS surveys, whereas fertility seems to have increased first and then decreased in rural areas. The slope for fertility in urban areas was significantly negative in 1982-2004 ($p = 0.0001$) and was very different from the rural slope for 1982-1997, which was significantly positive ($p = 0.047$); the difference between the slopes for urban and rural areas was highly significant. The negative slope for urban areas in 1997-2004 was also highly significant ($p < 0.0001$), although this slope was based on a small number of points. Fertility levels for both urban and rural areas peaked in 1998, which seems to have been an unusual year; this peak is highly significant and is not based on any obvious peculiarity. The peak levels might have been due to an abnormally high number of births recorded for 1998 by the 2004 survey (1,505 births were recorded that year, compared with 1,158 in 1997 and 1,059 in 1999).

Compared with earlier data, the increase in fertility in Chad between 1950 and 1980 appears remarkable. Detailed data are lacking for this period, but the pattern is consistent with that of other countries and with the increasing trend in rural areas prior to 1997.

Based on reconstructed trends, the onset of the fertility decline in Chad seems to have occurred in approximately 1985 in urban areas and some 12 years later in rural areas.

The premarital fertility level remained very low in Chad over the period covered by the DHS surveys, with the proportion of premarital births decreasing from 0.8 percent in 1982 to 0.4 percent in 2004. As a result, the national trends primarily reflect changes in marital fertility rates (Figure B.7.2).

Figure B.7.1 Trends in cumulated fertility by age 40, Chad, 1950-2005

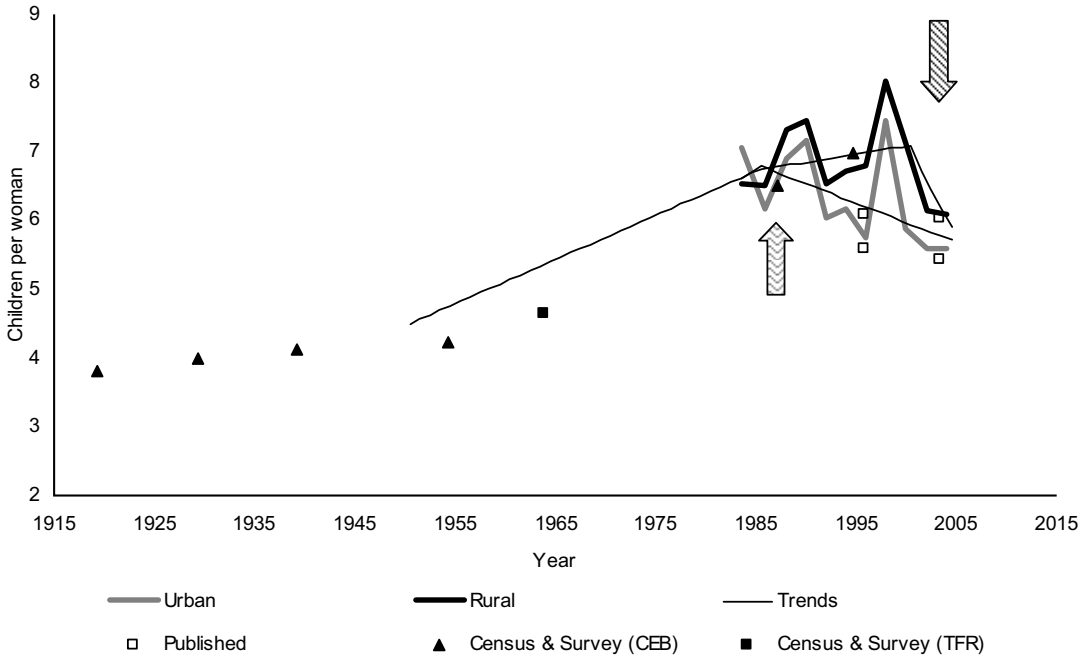
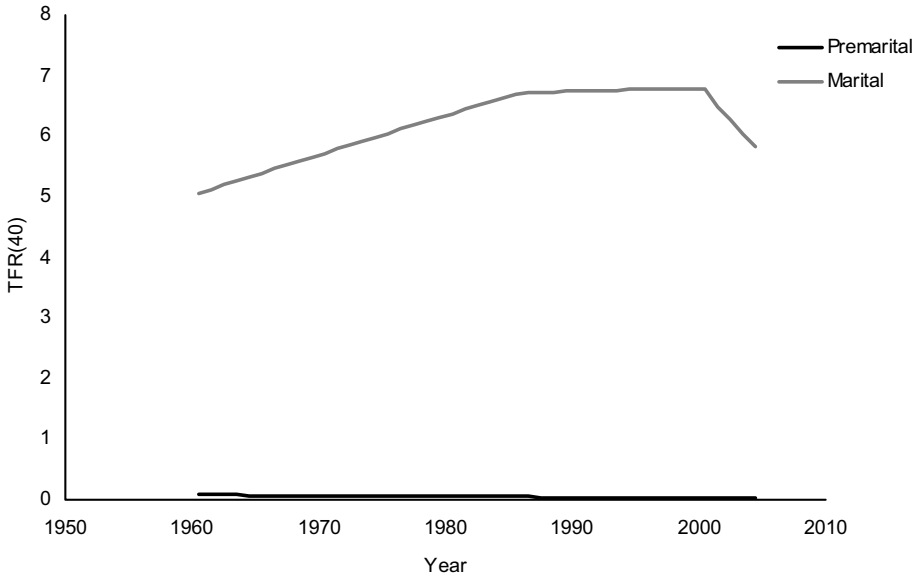


Figure B.7.2 Trends in Marital and Premarital Fertility, Chad, 1960-2005



Comoro Islands

The Comoro Islands have conducted only one DHS survey, in 1996. The survey covered 1981-1996 and showed two periods of monotonic trends: an increase from 1981 to 1987, followed by a decrease to 1996.

Few detailed data other than the DHS data were available for comparison. The 1996 DHS survey report mentions data from the 1991 census but does not provide details on these data. The 1991 census results are not consistent with the DHS survey data. Data on CFS and TFR from earlier censuses in 1958 and 1966 could be used, whereas published data from the 1980 census were already corrected and therefore could not be used. In any case, CFS appears to have been well below 5 prior to 1980, and probably below 4 prior to 1950 (Table B.8).

Table B.8 Estimated fertility levels, Comoro Islands, 1958-1991

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1958	CEB(45-49)	1948.5	3.33	3.7
Census, 1966	CEB(45-49)	1956.5	4.14	4.6
Period fertility				
Census, 1991	TFR(50)	1991.0	3.42	3.8

Period fertility trends in urban and rural areas differed in levels and slopes (Figure B.8.1). Between 1981 and 1988, fertility was still increasing in rural areas, whereas it was decreasing in urban areas. The declining trend in urban areas continued until the last year, 1996, for which data are available. Fertility declined at about the same rate in rural areas as urban areas between 1988 and 1996, the difference between the two slopes being not significant ($p = 0.233$). The change in slope in rural areas was highly significant ($p = 0.004$). The split between urban and rural areas seemed to have occurred in approximately 1980, the year of onset for the fertility decline in the Comoro Islands.

When the increasing trend in rural areas was extrapolated backward, the results were consistent with census estimates for CFS before 1960. TFR(40) in rural areas was estimated to be approximately 4.0 in 1950.

The proportion of premarital births remained very low over the period covered by the DHS survey, declining from 1.5 percent in 1981 to 0.7 percent in 1996 (Figure B.8.2)

Figure B.8.1 Trends in cumulated fertility by age 40, Comoro Islands, 1950-1996

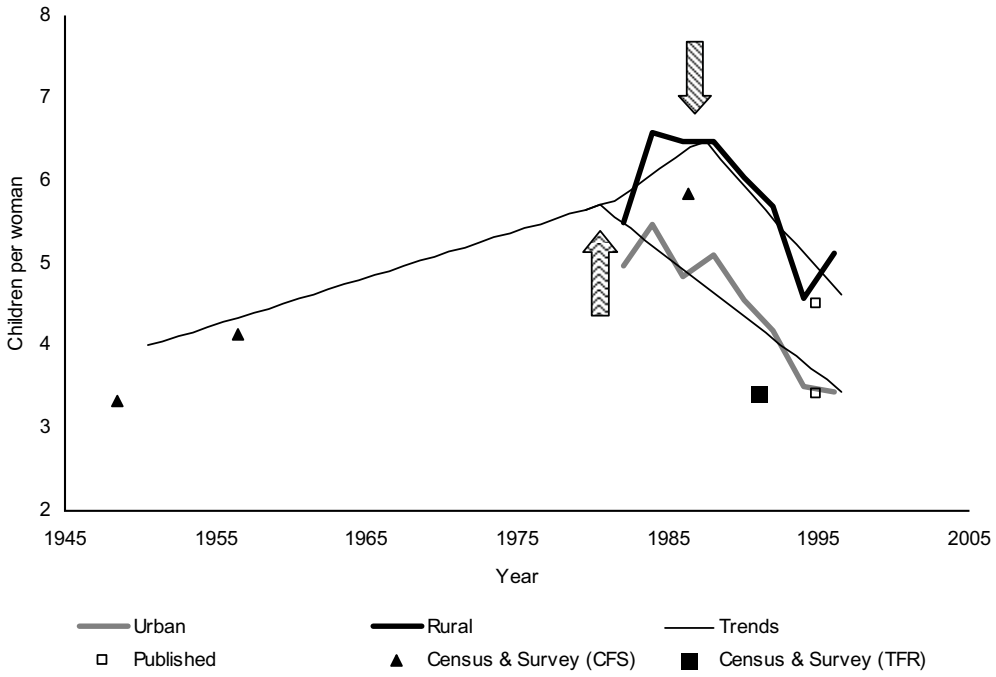
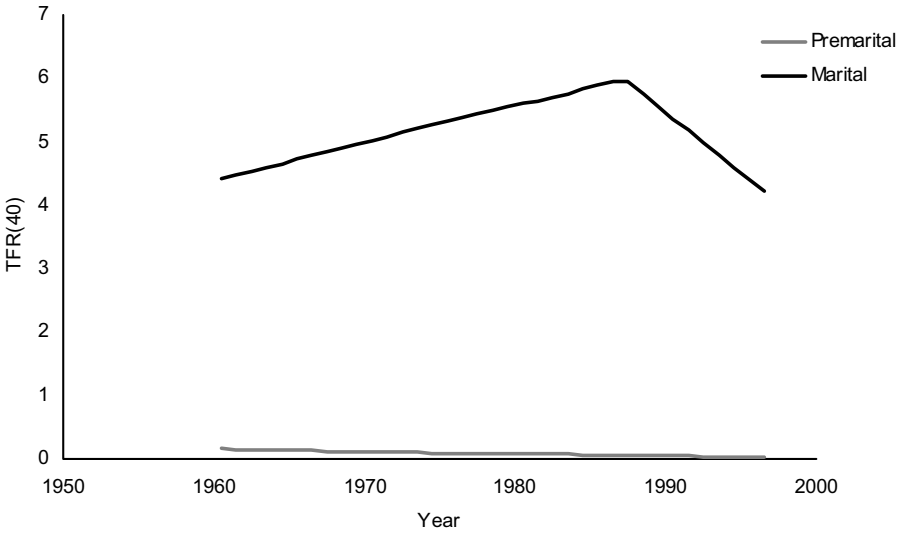


Figure B.8.2 Trends in Marital and Premarital Fertility, Comoro Islands, 1960-1996



Congo

The Democratic Republic of the Congo (formerly known as République Populaire du Congo or Congo-Brazzaville) conducted a DHS survey in 2005 covering 1990-2005. This survey showed declining trends in fertility.

A demographic survey conducted in 1961 and a 1984 census documented fertility trends in earlier years. CFS was low, with an average of 4.0, prior to 1950 and increased thereafter.

Table B.9 Estimated fertility levels, Democratic Republic of the Congo, 1915-1984

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1961	CEB(70+)	1915.9	3.58	3.98
Survey, 1961	CEB(60-69)	1925.9	3.70	4.11
Survey, 1961	CEB(50-59)	1935.9	4.02	4.47
Survey, 1961	CEB(40)	1950.9	3.99	4.32
Census, 1984	CEB(80+)	1929.5	3.28	3.64
Census, 1984	CEB(70-79)	1939.5	3.43	3.81
Census, 1984	CEB(60-69)	1949.5	3.60	4.01
Census, 1984	CEB(50-59)	1959.5	4.22	4.69
Census, 1984	CEB(40)	1974.5	5.30	5.21
Period fertility				
Survey, 1961	TFR(40)	1960.4	4.67	5.22
Census, 1984	TFR(40)	1984.0	4.29	4.84

The DHS survey results indicate a major discrepancy between fertility trends in urban and rural areas. The fertility decline was marked in urban areas between 1990 and 2005 ($p = 0.0005$), whereas fertility tended to increase in rural areas during this period, although the slope was not significantly higher than 0 ($p = 0.444$). The difference between the urban and rural slopes was highly significant ($p = 0.009$). The divergence between urban and rural areas seems to have started in approximately 1967.

Due to diverging trends in fertility and a relatively high urbanization rate, overall TFR(40) in Congo stayed roughly constant, at approximately 4.7 [TFR(50) = 5.2], between 1960 and 1990

When the rural trend was extrapolated backward, the resulting CFS was consistent with earlier estimates of CFS. Based on this extrapolation, fertility appears to have increased slightly between 1940 and 1960.

The proportion of premarital births declined markedly from 17.2 percent in 1990 to 12.5 percent in 2005. Extrapolating this trend backward to periods before 1990 is probably hazardous, but the results of this exercise suggest that marital fertility rates remained constant over the years because the decreasing fertility trend in urban areas was compensated by increasing proportions of marital births.

Figure B.9.1 Trends in cumulated fertility by age 40, Congo (Brazza), 1950-2005

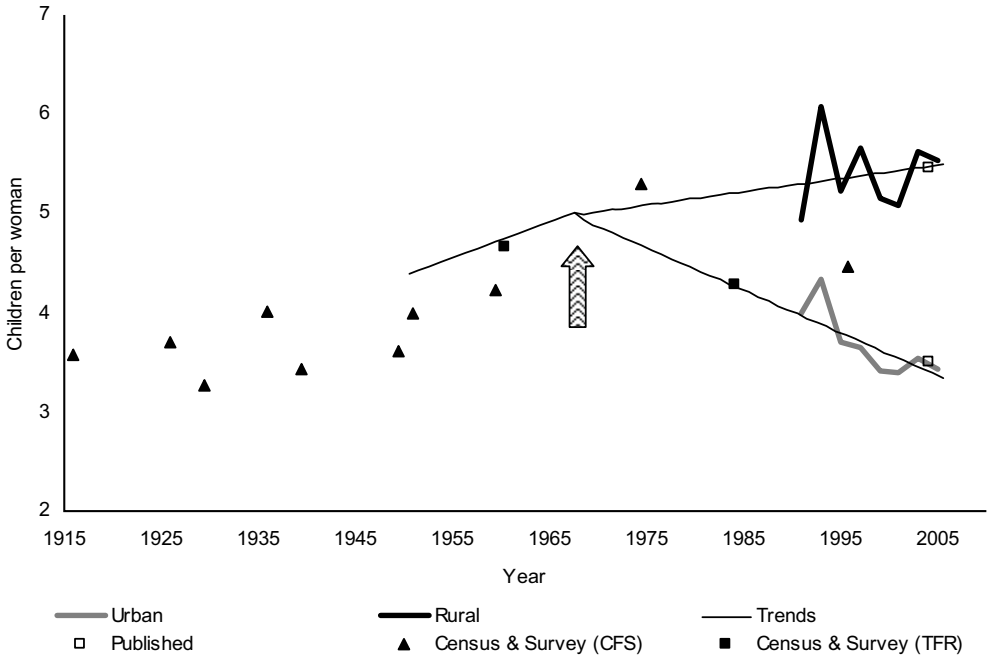
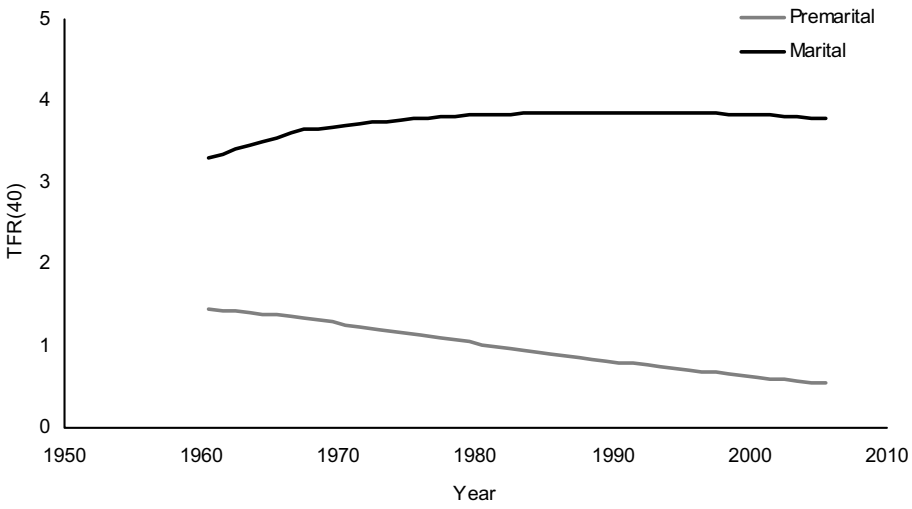


Figure B.9.2 Trends in Marital and Premarital Fertility, Congo (Brazza), 1960-2005



Côte d'Ivoire

Côte d'Ivoire conducted a WFS survey in 1980 and DHS surveys in 1994 and 1999, covering 1965 to 1999. The results of all three surveys showed similar fertility levels and trends. The 1980 WFS survey indicated that the fertility level was stable in 1965-1980, and the two DHS surveys showed that the rate declined between 1981 and 1999.

Additional data on fertility in Côte d'Ivoire were available from a demographic survey conducted in 1962-1964, a multiround survey conducted in 1978-1979, and the 1988 census (Table B.10). These data show that CFS increased between 1940 and 1970 and the TFR(40) remained constant between 1960 and 1990.

Table B.10 Estimated fertility levels, Côte d'Ivoire, 1943-1987

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1978-79	CEB(60+)	1943.4	4.75	5.28
Survey, 1978-79	CEB(50-59)	1953.4	5.04	5.60
Survey, 1978-79	CEB(40)	1968.4	5.82	6.10
Census, 1988	CEB(50+)	1963.2	5.18	5.75
Census, 1988	CEB(40)	1978.2	5.76	6.22
Period fertility				
Survey, 1962-64	TFR(40)	1962.5	5.65	6.38
Survey, 1978-79	TFR(40)	1977.9	5.75	6.38
EPR-Prospective	TFR(40)	1978.9	5.94	6.54
Census, 1988	TFR(40)	1987.7	5.58	6.29

WFS and DHS data indicate divergent trends in urban and rural areas. In urban areas, fertility declined slowly between 1966 and 1982, with a non-significant slope ($p = 0.254$), then declined rapidly from 1982 to 1999 ($p < 0.0001$). In rural areas, fertility increased between 1966 and 1987, with a significantly positive slope ($p = 0.030$), then declined rapidly from 1987 to 1999, with a negative slope ($p < 0.0001$). The differences in slopes in 1966-1982 between urban and rural areas was significant ($p = 0.050$), whereas the speeds were similar in 1982-1999 ($p = 0.831$).

Compared with the reconstructed trends, TFR estimates from all 1962-1964 and 1978-1979 surveys and the 1988 census were more frequently lower than the estimates from the DHS survey results (7 percent lower in 1962-1964, 10 percent lower in 1978-1979, and 13 percent lower in 1991). The differences between the TFR estimates from the reconstructed trends, the DHS survey estimates, and estimates from the census and other surveys are somewhat surprising. These differences could be due to a systematic deficiency in the 1962-1964 and 1978-1979 surveys or a selection bias in the DHS survey favoring households with more fertile women.

The proportion of premarital births increased rapidly, from an estimated 5.1 percent in 1966 to 12.9 percent in 1999. As a result, premarital fertility increased steadily from 1966 to 1987 and declined only slightly afterwards. In contrast, marital fertility rates stopped increasing after 1970 and underwent a major decline after 1986 (Figure B.10.2).

Figure B.10.1 Trends in Cumulated Fertility by Age 40, Côte d'Ivoire, 1950-1999

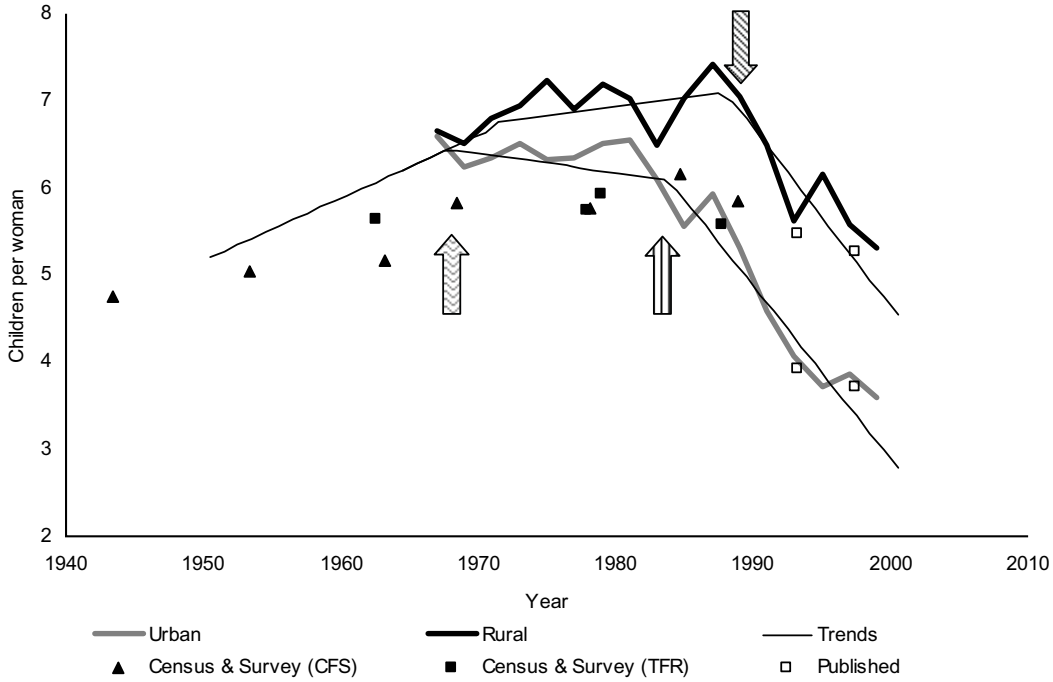
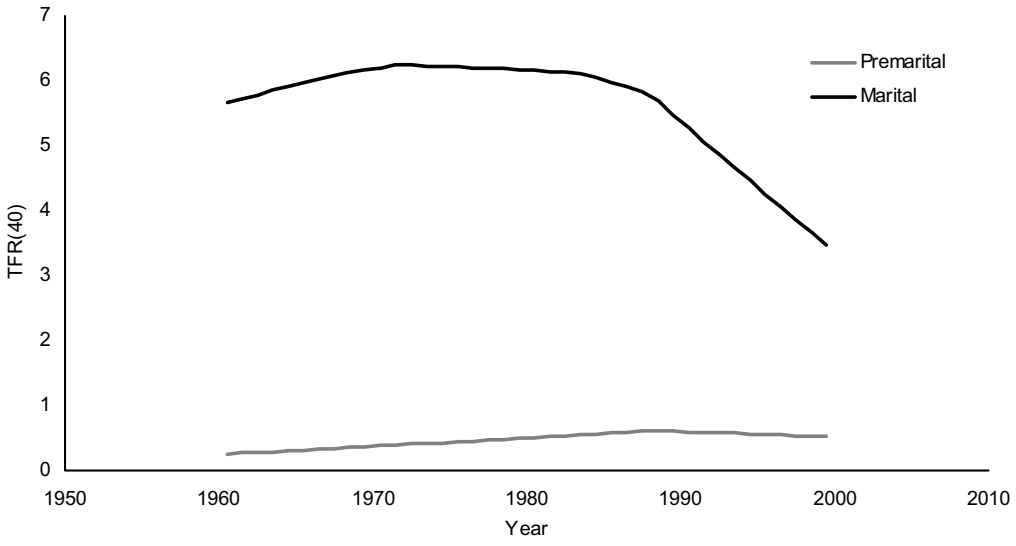


Figure B.10.2 Trends in Marital and Premarital Fertility, Cote d'Ivoire, 1960-1999



Ethiopia

Ethiopia conducted DHS surveys in 2000 and 2005, covering 1985-2005. The fertility levels and trends from the results of the two surveys are similar, although the 2005 survey yielded higher estimates for the overlapping period, 1994-1999, despite similar estimates in 1993 and 2000. Both surveys indicate declining fertility levels in Ethiopia since the earliest years covered.

Other data on fertility in Ethiopia come from censuses in 1984 and 1994 and surveys in 1990 and 1998 (Table B.11). These censuses and surveys do not cover periods prior to 1969, and the baseline level in Ethiopia therefore remains unknown. The available data indicate a rise in fertility from 1970 to 1990; this is consistent with trends in other sub-Saharan African countries and with the DHS survey results.

Table B.11 Estimated fertility levels, Ethiopia, 1969-1990

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1984	CEB(40)	1974.5	4.95	5.30
Survey, 1990	CEB(40)	1980.5	6.00	6.60
Census, 1994	CEB(50+)	1969.8	5.02	5.58
Census, 1994	CEB(40)	1984.8	5.65	6.10
Survey, 1998	CEB(40)	1988.5	6.05	6.80
Period fertility				
Survey, 1990	TFR(40)	1990.0	5.58	6.38

DHS data indicate a rapid period fertility decline in both urban and rural areas, with an earlier onset in urban areas. Based on the assumption that the trend prior to 1990 was roughly parallel to the estimated CFS trend, the urban fertility decline began in approximately 1980 and the rural fertility decline started in approximately 1990. The 1990 survey estimate for period fertility (urban and rural areas combined) is within the range of DHS estimates, providing additional evidence for the consistency of the Ethiopian data. The level of fertility in urban areas in 2005 [TFR(50)= 2.06] was lower than the net reproduction level, which is rare in sub-Saharan African countries other than South Africa.

The premarital fertility level remained very low in Ethiopia, with a significant decline in the proportion of premarital births from 0.9 percent in 1985 to 0.6 percent in 2005 ($p = 0.006$). As a result, the overall changes in fertility in Ethiopia reflect primarily changes in marital fertility (Figure 11.2).

Figure B.11.1 Trends in Cumulated Fertility by Age 40, Ethiopia, 1960-2005

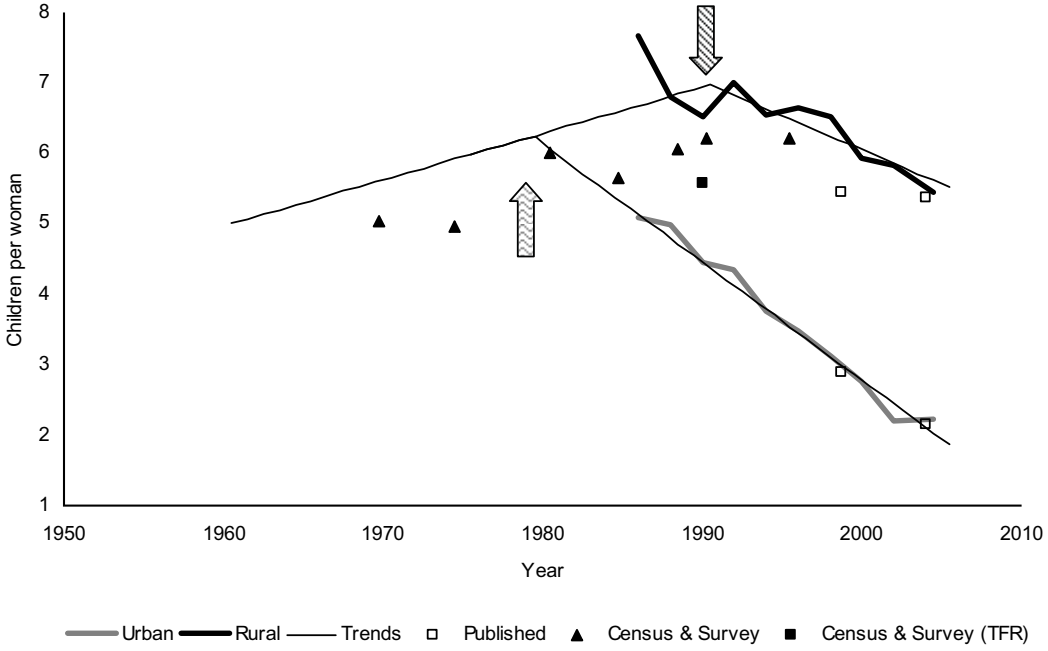
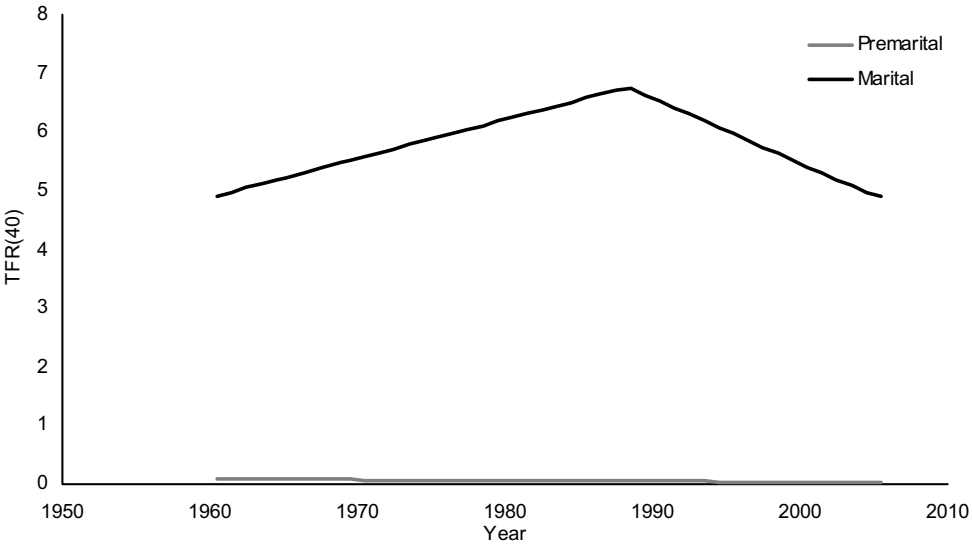


Figure B.11.2 Trends in Marital and Premarital Fertility, Ethiopia, 1960-2005



Gabon

Gabon conducted only one DHS survey, in 2001. The results of this survey indicate that Gabon experienced a steady fertility decline over the period covered (1986-2001).

Two other data sources complement the DHS survey data: a survey in 1961 and a census in 1993 (Table B.12). The data from this survey and census show that, unlike other sub-Saharan African countries, Gabon had a very low fertility level prior to 1950 and probably had declining fertility levels from 1915 to 1950. The very low fertility level in the first half of the 20th century is associated with extremely high levels of infertility identified in the 1961 survey report. For example, 36 percent of women age 40-44 in 1961 had never had any live birth and this proportion increased over time; only 20 percent of women age 70 or older in 1961 had been infertile during their childbearing years, compared to 22 percent of women age 65-69, 26 percent of women age 60-64, 28 percent of women age 55-59, 30 percent of women age 50-54, and 32 percent of women age 45-49. The infertility level subsequently dropped rapidly to 12 percent of women age 40-44 in 1993 and 3 percent in 2001. Women born between 1915 and 1925 appear to have experienced the highest infertility rates. Since 1925, infertility has declined steadily, reaching levels comparable to those of other countries for women born in the 1960s (Figure B.12.3). The low fertility level in 1950 closely corresponds to the peak of infertility (1920 cohort).

Table B.12 Estimated fertility levels, Gabon, 1916-1993

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1961	CEB(70+)	1916.5	3.13	3.48
Survey, 1961	CEB(60-69)	1926.5	2.97	3.30
Survey, 1961	CEB(50-59)	1936.5	2.67	2.97
Survey, 1961	CEB(40)	1951.5	2.49	2.78
Census, 1993	CEB(60+)	1958.5	2.57	2.86
Census, 1993	CEB(50-59)	1968.5	3.75	4.17
Census, 1993	CEB(40)	1983.5	4.92	4.98
Period fertility				
Survey, 1961	TFR(40)	1961.0	3.80	4.15
Census, 1993	TFR(40)	1993.0	3.98	4.36

Period fertility trends in urban areas during the period covered by the DHS survey, 1986-2001, were much more pronounced than in rural areas (Figure B.12.1). Both trends were significantly negative ($p < 0.0001$) and their slopes were significantly different from one another ($p < 0.0001$). The intersection between the trends occurred in 1984, when the fertility transition in Gabon began. The reconstruction suggests a major period fertility increase, from 3.2 to 6.1, between 1950 and 1984; this is one of the most substantial increases in sub-Saharan Africa.

The proportion of premarital births in Gabon was high, with an average level of 20 percent in 1986-2001. The premarital fertility level increased slightly during this period, but the change was not significant ($p = 0.49$). As a result, the trends in premarital and marital fertility in 1986-2001 were similar to the overall fertility trends (Figure B.12.2)

Figure B.12.1 Trends in Cumulated Fertility by Age 40, Gabon, 1950-2001

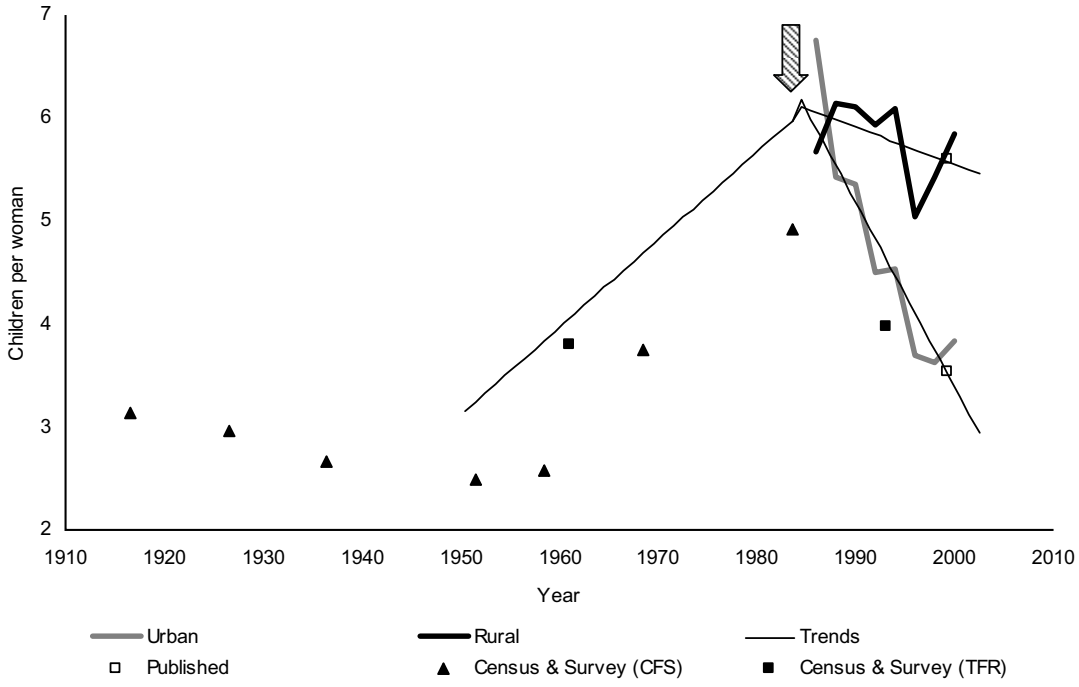


Figure B.12.2 Trends in Marital and Premarital Fertility, Gabon, 1960-2001

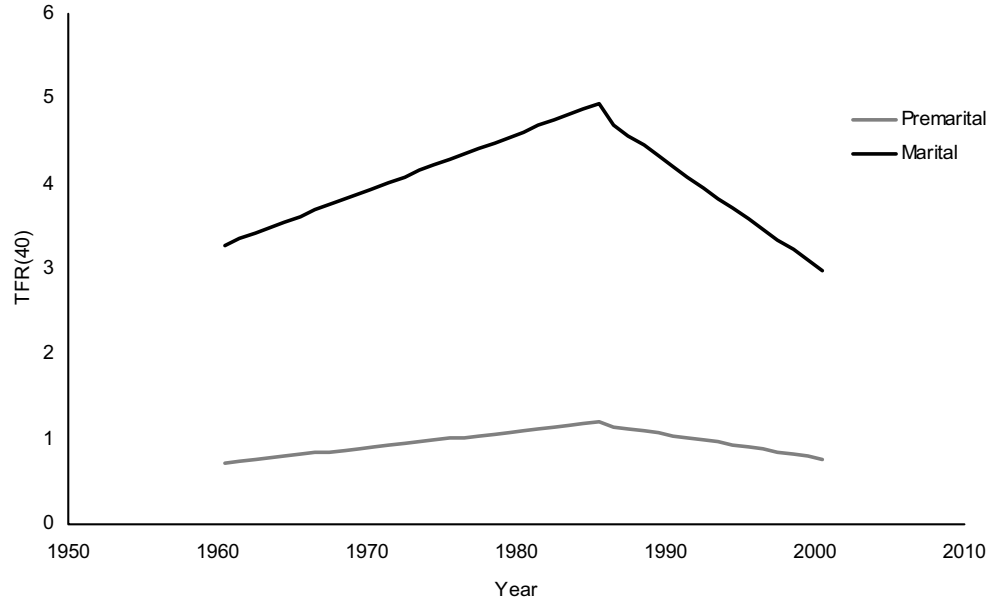
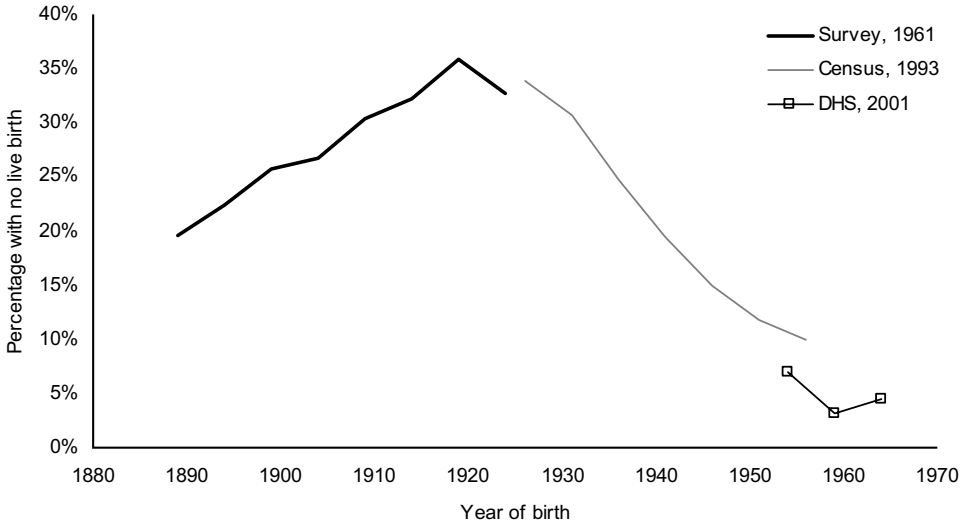


Figure B.12.3 Trends in infertility, Gabon, 1890-1965



Ghana

Ghana conducted a WFS survey in 1979 and DHS surveys in 1988, 1993, 1998, and 2003; these surveys covered 1964-2003. Overall, the results from these surveys indicate the same fertility levels and trends, with a plateau in the first survey and declining trends in the four DHS surveys.

Ghana conducted censuses in 1948 and 1960 and a survey in 1971 used in this analysis to supplement the DHS survey data (Table B.13). Data from these sources indicate that TFR(40) was probably stable before 1950 at approximately 5.8 children per woman [CFS(50) = 6.4]; this is consistent with the levels found in later surveys.

This analysis is based on the WFS and DHS surveys, as well as a 1971 survey and the 1948 and 1960 censuses. More data are apparently available elsewhere but access to these data was not available.

Table B.13 Estimated fertility levels, Ghana, 1938-1971

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1948	CEB(40)	1938.5	5.94	6.60
Census, 1960	CEB(40)	1950.2	5.60	6.22
Survey, 1971	CEB(40)	1961.5	5.85	6.50
Period fertility				
Survey, 1971	TFR(40)	1971.0	5.24	5.92

The WFS and DHS survey results indicate divergent trends in urban and rural areas. In urban areas, fertility declined slowly from 1965 to 1975 (the slope was not significant), then more rapidly from 1975 to 1998; the fertility rate stalled from 1998 to 2003. Both changes in slopes were significant ($p = 0.013$ for 1965-1975 and $p = 0.0003$ for 1975-1998). In rural areas, fertility was stable from 1965 to 1985 before decreasing ($p < 0.0001$); as in urban areas, fertility levels in rural areas stalled between 1998 and 2003. As with urban areas, changes in slope for rural areas were significant ($p < 0.0001$ for 1965-1985 and $p = 0.001$ for 1985-1998). The fertility stall in Ghana (1998-2003) is similar to that in Kenya during approximately the same period. More research is needed on Ghana's fertility stall, which might simply be a small, short-lived historical accident in the fertility transition.

Premarital fertility had a low prevalence in Ghana, but the proportion of premarital births doubled from 1.9 percent 1965 to 3.9 percent in 2003. As a result, the premarital fertility level tended to increase over time, whereas marital fertility levels were similar to those of the overall population (Figure 13.2).

Figure B.13.1 Trends in Cumulated Fertility by Age 40, Ghana 1950-2003

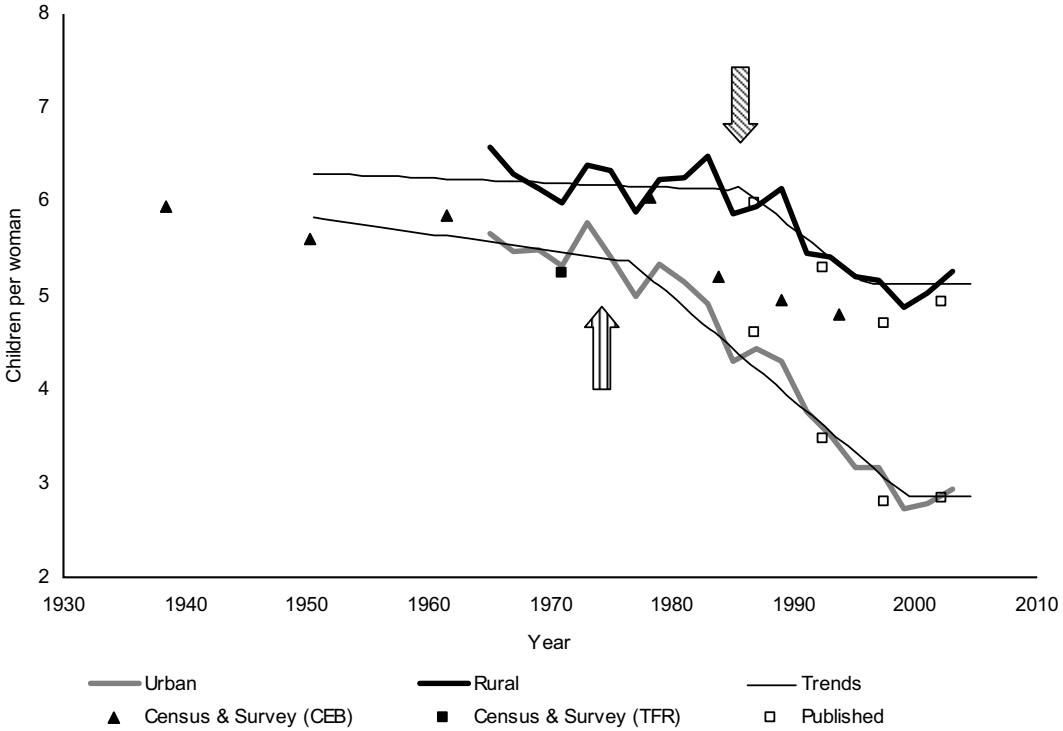
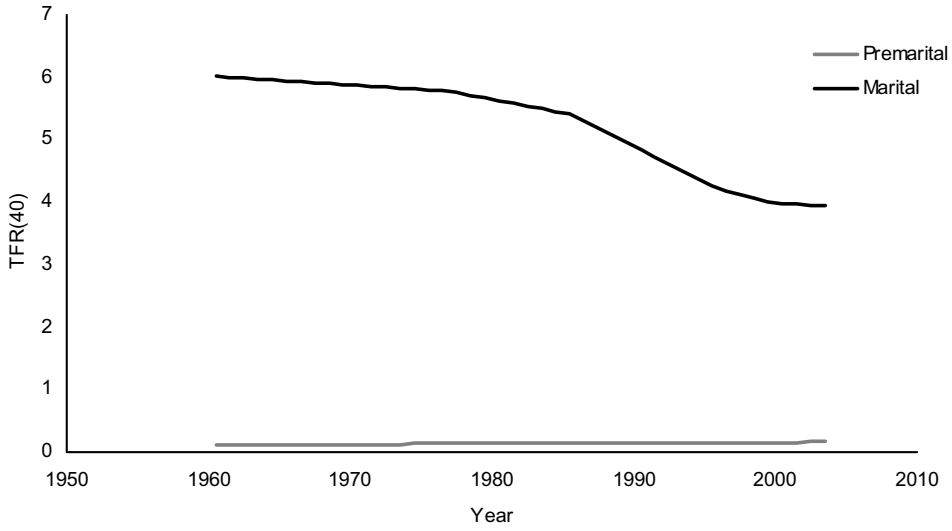


Figure B.13.2 Trends in Marital and Premarital Fertility, Ghana 1960-2003



Guinea

Guinea (also known as République de Guinée or Guinée-Conakry) conducted three DHS surveys, in 1992, 1999, and 2005. Unfortunately, access to the 1992 survey data was not available, so this analysis is based only on the results from the 1999 and 2005 DHS surveys, which covered 1984-2005.

Fertility data are also available from a survey conducted by France's Institut National de la Statistique et des Études Économiques (INSEE) in francophone Africa in 1955 and censuses in 1983 and 1996 (Table B.14). These data indicate that TFR(40) was probably stable in Guinea before 1950 at approximately 4.9 (CFS = 5.5) and it might have been decreasing slightly. Since 1950, fertility increased steadily until the mid-1980s.

Table B.14 Estimated fertility levels, Guinea, 1910-1996

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
INSEE survey, 1955	CEB(70+)	1910.3	5.08	5.64
INSEE survey, 1955	CEB(60-69	1920.3	4.98	5.54
INSEE survey, 1955	CEB(50-59)	1930.3	4.82	5.36
INSEE survey, 1955	CEB(40)	1945.3	4.75	5.33
Period fertility				
INSEE survey, 1955	TFR(40)	1954.8	6.58	7.06
Census, 1983	TFR(40)	1982.6	4.39	4.88
Census, 1996	TFR(40)	1996.0	5.44	5.96

DHS data indicate a marked fertility decline in urban areas in 1986-2005; the slope was highly significant ($p < 0.0001$). In contrast, fertility increased in rural areas between 1984 and 1995; again, the slope was highly significant ($p < 0.0001$). After 1995, fertility started to decline steadily and rapidly in rural areas between 1995 and 2005; the slope was equivalent to that for urban areas ($p = 0.347$). The turning point for Guinea's fertility transition appears to have been 1986, when the fertility decline started in urban areas (Figure B.14.1).

Premarital fertility had a continuously low prevalence in Guinea. However, the proportion of premarital births increased from an estimated 1.9 percent in 1984 to 3.4 percent in 2005; this increase was highly significant ($p < 0.0001$). Because premarital fertility was so low, the trend for marital fertility was similar to the national trend, and premarital fertility tended to increase steadily over this period (Figure B.14.2).

Figure B.14.1 Trends in Cumulated Fertility by Age 40, Guinea, 1950-2005

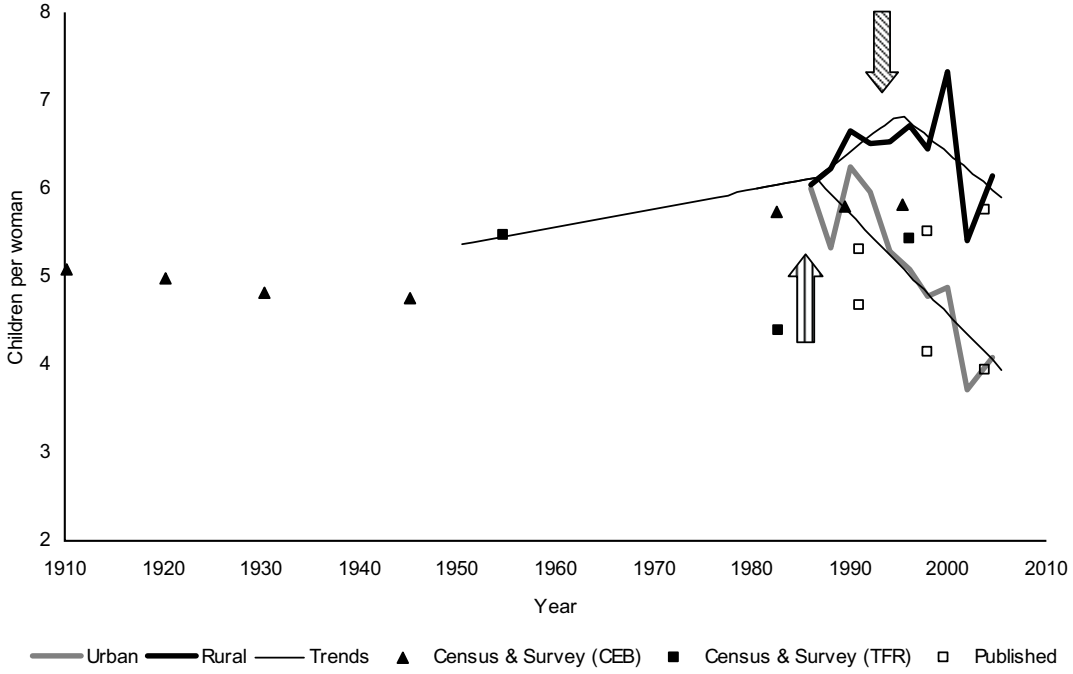
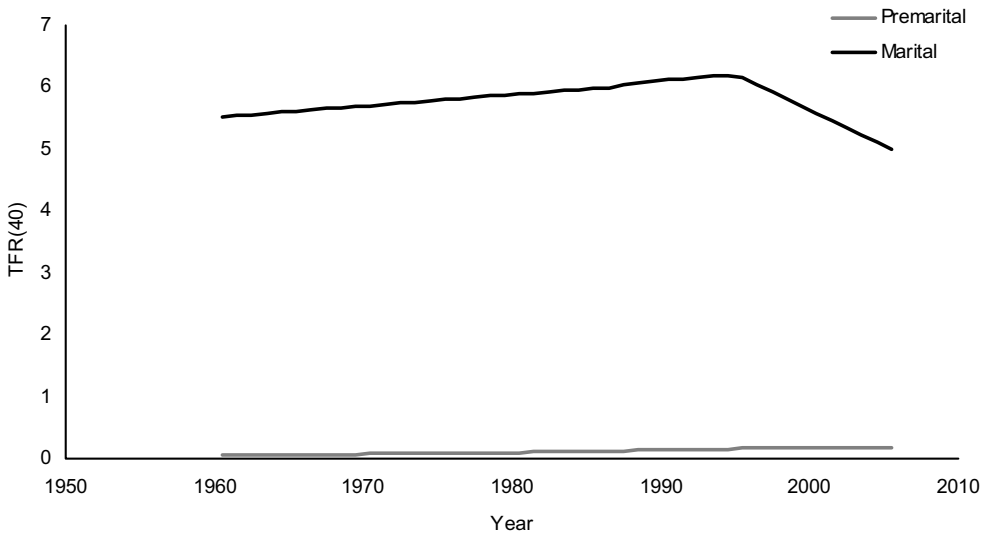


Figure B.14.2 Trends in Marital and Premarital Fertility, Guinea, 1960-2005



Kenya

Kenya conducted a WFS survey in 1978 and DHS surveys in 1989, 1993, 1998, and 2003; these surveys covered 1963-2003. The fertility levels and trends from the results of all five surveys are consistent; these data show a decline starting in the mid-1960s, followed by a fertility stall after 1995.

A wealth of other demographic data is available on Kenya, including censuses in 1962, 1969, 1979 and surveys in 1977 and 1984 (Table B.15). Data from these censuses and surveys suggest a major increase in fertility before 1950, with the CFS rising from 4.0 in 1920 to 6.0 in 1950. A substantial decrease started in the 1950s, a time of severe crisis during Kenya's struggle for independence. After 1960, fertility apparently increased dramatically, reaching very high levels in the late 1960s. These trends had a similar pattern to the 1920-1950 trends.

Table B.15 Estimated fertility levels, Kenya, 1917-1984

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1962	CEB(70-79)	1917.6	3.94	4.37
Census, 1962	CEB(60-69)	1927.6	4.66	5.18
Census, 1962	CEB(50-59)	1937.6	5.20	5.78
Census, 1962	CEB(40)	1952.6	5.34	5.90
Census, 1969	CEB(60-69)	1934.6	5.20	5.78
Census, 1969	CEB(50-59)	1944.6	5.76	6.40
Census, 1969	CEB(40)	1959.6	4.68	6.69
Survey, 1977	CEB(40)	1967.5	7.00	7.50
Census, 1979	CEB(40)	1969.5	6.75	7.20
Survey, 1984	CEB(40)	1974.5	7.40	8.20
Period fertility				
Census, 1962	TFR(40)	1962.1	4.40	5.25
Census, 1969	TFR(40)	1969.1	5.69	6.60
Survey, 1977	TFR(40)	1977.0	7.04	7.99
Census, 1979	TFR(40)	1979.0	7.28	7.88
Survey, 1984	TFR(40)	1984.0	6.82	7.69

The WFS and DHS survey results show substantial differences between fertility levels and trends in urban and rural areas. Fertility levels were already lower in urban areas than in rural areas in 1965 and continued to decline steadily until 1995 ($p < 0.00001$). After 1995, fertility in urban areas remained stable ($p = 0.522$). The changes in the slopes for urban areas before and after 1995 were highly significant ($p < 0.00001$). In rural areas, fertility remained high from 1963 until 1980, when it decreased slightly but significantly ($p = 0.016$). After 1980, fertility in rural areas decreased rapidly ($p < 0.00001$) before stalling at approximately the same time as in urban areas ($p = 0.160$). The changes in slope in 1963-1980 and 1980-1995 were highly significant ($p < 0.00001$). Based on the assumption that fertility increased substantially in the 1960s, the split between urban and rural areas apparently occurred in the mid-1960s, when Kenya established its family planning program.

The proportion of premarital births increased dramatically, from approximately 4.9 percent in 1963 to 9.6 percent in 1996 before declining to approximately 8 percent in 2003. The decline in the premarital fertility level occurred during Kenya's fertility stall. As a result, premarital fertility increased between 1963 and 1981, decreased from 1981 to 1995, and increased again from 1995 to 2003, with an average of 0.45 children per woman. In contrast, marital fertility followed the same pattern as the overall population: an increase, decrease, and stall (Figure B.15.2).

This reconstruction is generally consistent with that of Blacker (2007).

Figure B.15.1 Trends in Cumulated Fertility by Age 40, Kenya 1950-2002

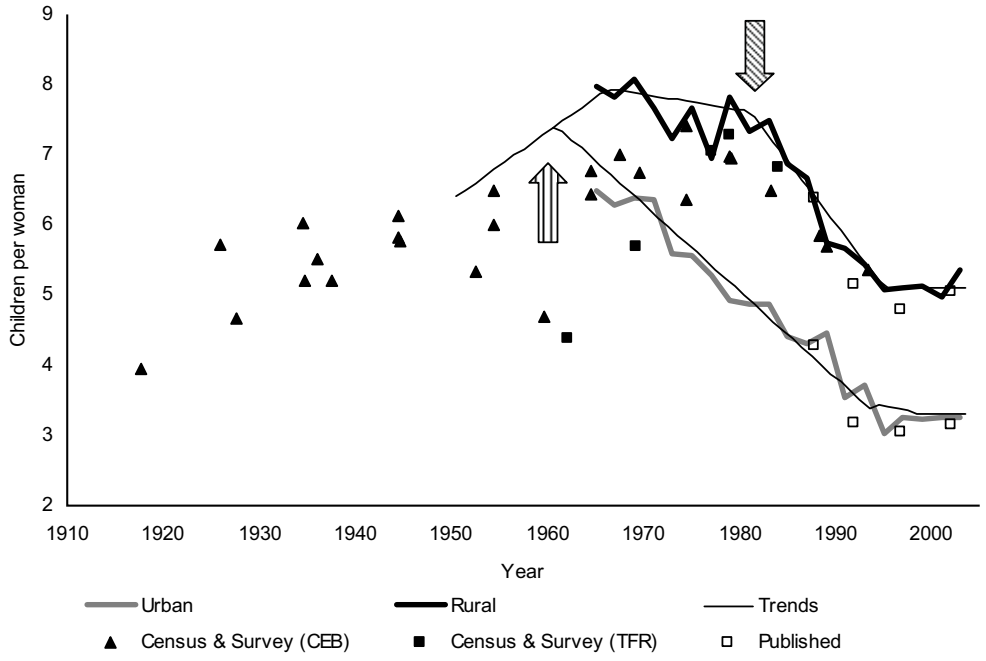
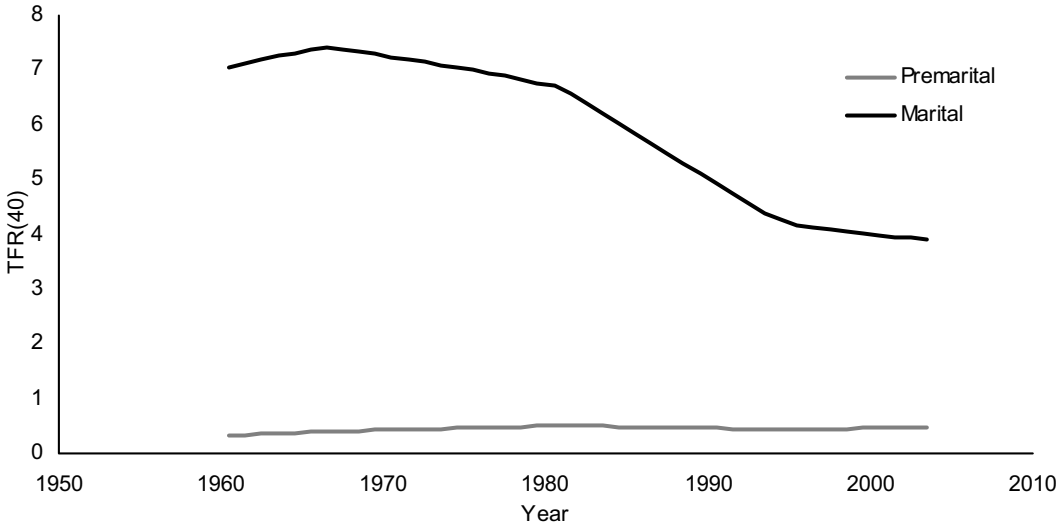


Figure B.15.2 Trends in Marital and Premarital Fertility, Kenya, 1960-2003



Lesotho

Lesotho conducted a WFS survey in 1977 and a DHS survey in 2004; these surveys covered 1962-2004. Fertility levels and trends based on results from the two surveys were similar. The 1979 WFS survey results showed an increase in TFR(40) from 4.8 in 1962 to 5.9 in 1977. The 2004 DHS survey results showed a decrease in TFR(40) from 4.6 in 1989 to 3.0 in 2004. The two trends intersected in 1977, the year when fertility in Lesotho was at its peak.

Several censuses in 1976, 1986, 1996 and a 2001 survey provide additional data on fertility in Lesotho; the 2004 DHS survey report includes data from all of these sources. Unfortunately, access to original data on CEB from Lesotho's censuses was not available. TFR(40) in the WFS survey was 4.9, on average, in women born between approximately 1925 and 1939. Therefore, period fertility was probably stable, at less than 5 children per woman, before 1960.

Table B.16 Estimates of fertility level, Lesotho

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Period fertility				
1976 Census	1976.5	1976.0	4.75	5.43
1986 Census	1986.5	1986.0	4.87	5.49
1996 census	1996.5	1996.0	2.86	3.33
2001 LDS	2001.5	1999.0	3.76	4.20

Trends in urban and rural areas were parallel, with an almost steady gap (Figure B.16.1). In 1962-1976, fertility increased at similar rates in the two areas; the difference in slopes was not significant ($p = 0.737$). However, the fertility decline was more rapid in urban areas in 1976-2004, and the slopes for urban and rural areas were significantly different ($p = 0.014$).

Premarital fertility had a low prevalence in the WFS survey results. However, the proportion of premarital births increased rapidly, from an estimated 0.9 percent in 1963 to 12.1 percent in 2004. As a result, premarital fertility increased steadily over the period covered by the WFS and DHS surveys, reaching 0.4 children per women in 2004. In contrast, marital fertility followed the same pattern as fertility for overall population in that it increased and then decreased.

Figure B.16.1 Trends in Cumulated Fertility by Age 40, Lesotho, 1950-2004

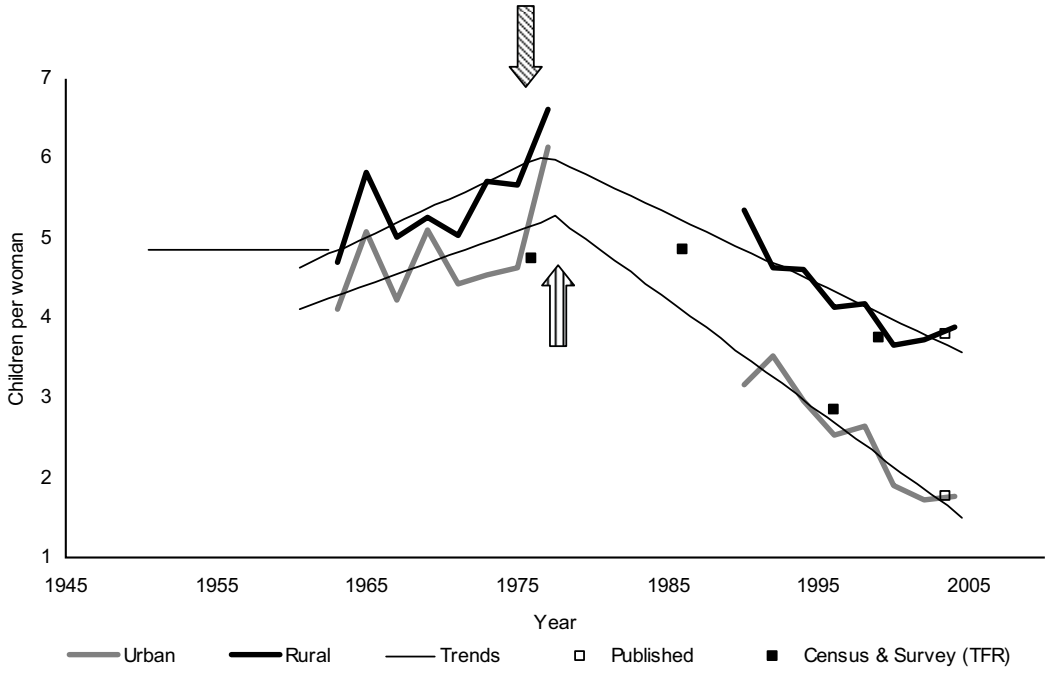
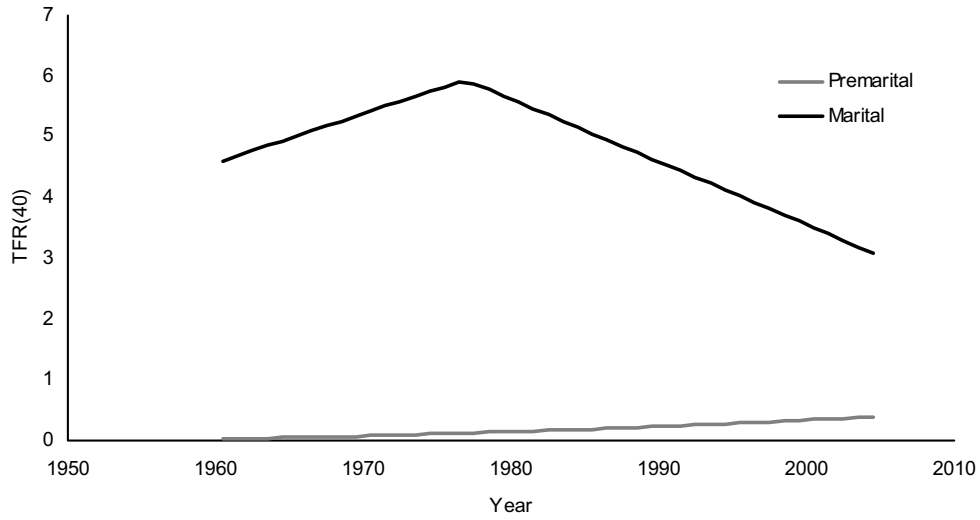


Figure B.16.2 Trends in Marital and Premarital Fertility, Lesotho, 1960-2005



Liberia

Liberia conducted only one DHS survey, in 1986. This survey showed no clear trend over the period covered, 1971-1986.

Data from a 1971 survey and a 1974 census provide additional evidence on fertility in Liberia (Table B.17). These data show that the period fertility level prior to 1950 was low, at less than 4.0 children per women, and was probably increasing slowly. The fertility level seems to have increased rapidly in the 1950s and 1960s to reach 6.0 in 1971, according to the DHS survey results. The estimates of TFR from the 1971 survey and the 1974 census are consistent with the reconstruction.

Table B.17 Estimated fertility levels, Liberia, 1936-1974

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1971	CEB(60-69)	1936.5	3.51	3.90
Survey, 1971	CEB(50-59)	1946.5	3.70	4.11
Survey, 1971	CEB(40)	1961.5	4.43	4.67
Period fertility				
Survey, 1971	TFR(40)	1970.0	5.59	6.27
Survey, 1971	TFR(40)	1971.0	5.35	5.72
Census, 1974	TFR(40)	1974.0	5.83	6.48

DHS data show diverging trends in urban and rural areas between 1971 and 1986 (Figure B.17.1). The difference in slopes for the rural and urban trends was highly significant ($p < 0.0001$). Liberia's fertility decline apparently started in approximately 1971, the first year covered by the DHS survey, although fertility continued to increase in rural areas between 1971 and 1986, continuing the country's previous trend. The changes in urban and rural fertility levels between 1971 and 1986 tended to compensate for one another so, as a result, the changes in the national fertility level during this period were not significant. Applying the proportion urban (from the United Nations database) to both urban and rural trends shows a slightly increasing trend nationwide.

The prevalence of premarital fertility in Liberia was high, in contrast to neighboring countries, and increasing rapidly during the period covered by the DHS survey. The estimated proportion of premarital births was 7.7 percent in 1971 and 11.5 percent in 1986. As a result, the premarital fertility level tended to increase between 1971 and 1986, reaching 0.7 children per woman in 1986. The fertility trend for marital fertility was similar to the trend for the overall population (Figure B.17.2)

Figure B.17.1 Trends in Cumulated Fertility by Age 40, Liberia, 1950-1986

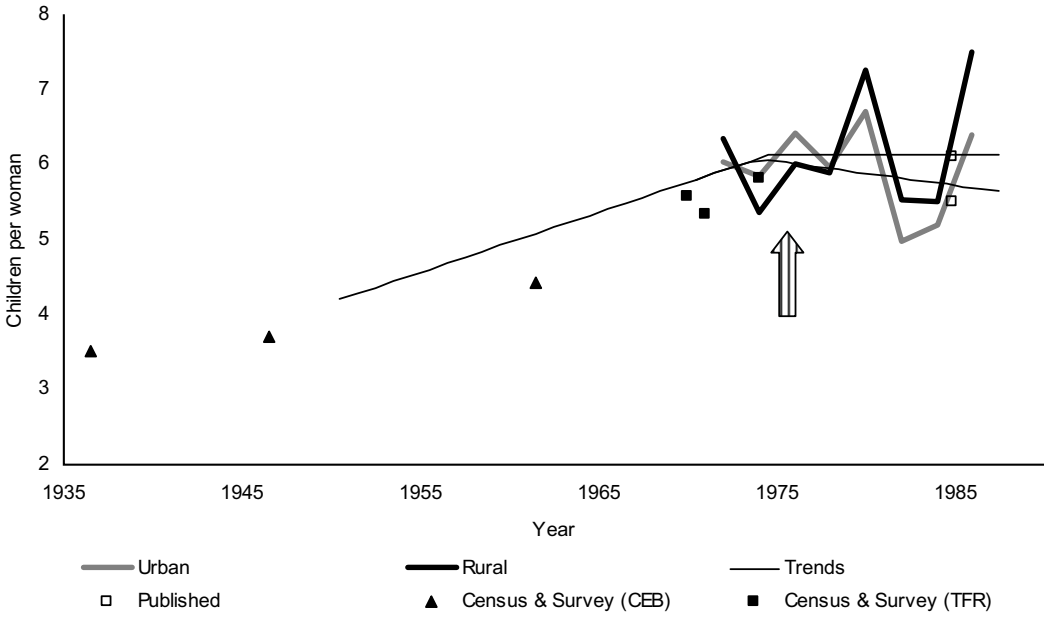
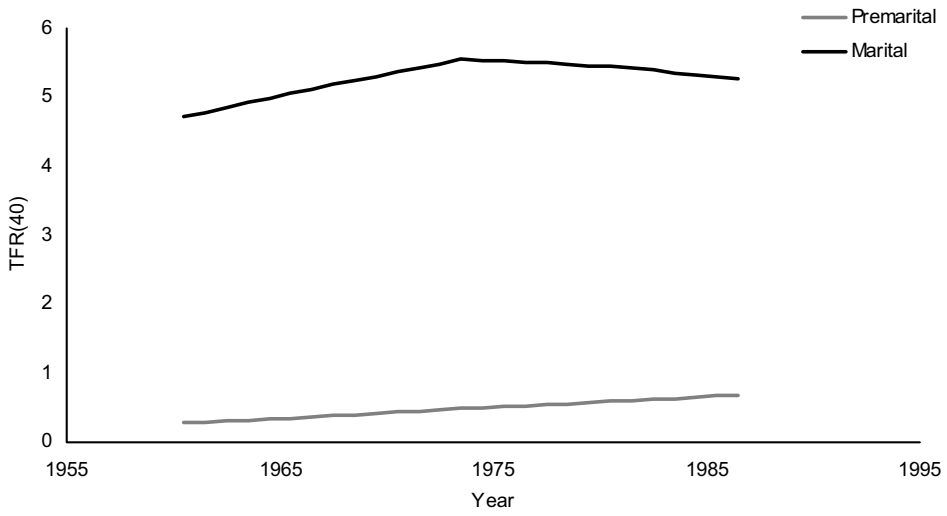


Figure B.17.2 Trends in Marital and Premarital Fertility, Liberia, 1960-1986



Madagascar

Madagascar conducted DHS surveys in 1992, 1997, and 2003, covering 1977-2003. Results from the three surveys show consistent fertility levels and trends; all three indicate that fertility levels declined after 1980.

In addition, fertility data are available from a 1966 survey, a 1975 census, and a 1980 survey (Table B.18). Data from these sources indicate that the fertility level was very low prior to 1950, with an average TFR(40) of 2.7 (CFS = 3.0), although the TFR(40) probably increased over time. Estimated fertility increased steadily after 1950, reaching a peak in approximately 1975.

Table B.18 Estimated fertility levels, Madagascar, 1940-1980

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1966	CEB(40)	1956.0	4.03	4.48
Census, 1975	CEB(60+)	1940.5	2.40	2.67
Census, 1975	CEB(50-59)	1950.5	2.97	3.30
Census, 1975	CEB(40)	1965.5	4.05	3.86
Period fertility				
Survey, 1966	TFR(40)	1965.5	4.69	5.13
Census, 1975	TFR(40)	1975.0	5.56	6.39
Survey, 1980	TFR(40)	1980.0	4.95	5.76

DHS data show divergent and complex trends in urban and rural areas (Figure B.18.1). In urban areas, fertility declined rapidly between 1977 and 1986 ($p = 0.005$). After a stall for approximately 7 years ($p = 0.217$), fertility began to decline again in 1993 and continued to decline until the last year for which data are available, 2003. The changes in slope and were highly significant ($p = 0.004$ for 1977-1986 and $p = 0.006$ for 1993-2003).

In rural areas, fertility decreased slowly between 1977 and 1986 and the slope was not significant ($p = 0.122$). It is possible that the slow decrease in 1977-1980 simply reflected the end of the fertility increase that had occurred between 1950 and 1975. Like urban areas, rural areas experienced a fertility stall, in 1986-1992; the fertility slope became positive during this period but was not significantly higher than 0 ($p = 0.243$). However, the change in slope from 1988-1992 to 1992-2003 had borderline significance ($p = 0.058$). The fertility decline in rural areas after 1992 was rapid and had a similar slope to that of urban areas during this period ($p = 0.864$). The apparent fertility stall in urban and rural areas occurred immediately after a turbulent period during the mid-1980s. It is possible that fertility became lower than expected during the mid-1980s before resuming its previous trend, resulting in apparent increases and decreases.

The proportion of premarital births in Madagascar increased from 5.5 percent in 1977 to 7.2 percent in 2004. As a result, the premarital fertility level remained flat between 1977 and 2004, at about 0.36 children per woman, whereas marital fertility followed the same trend as the general population's fertility trend.

Figure B.18.1 Trends in Cumulated Fertility by Age 40, Madagascar, 1950-2003

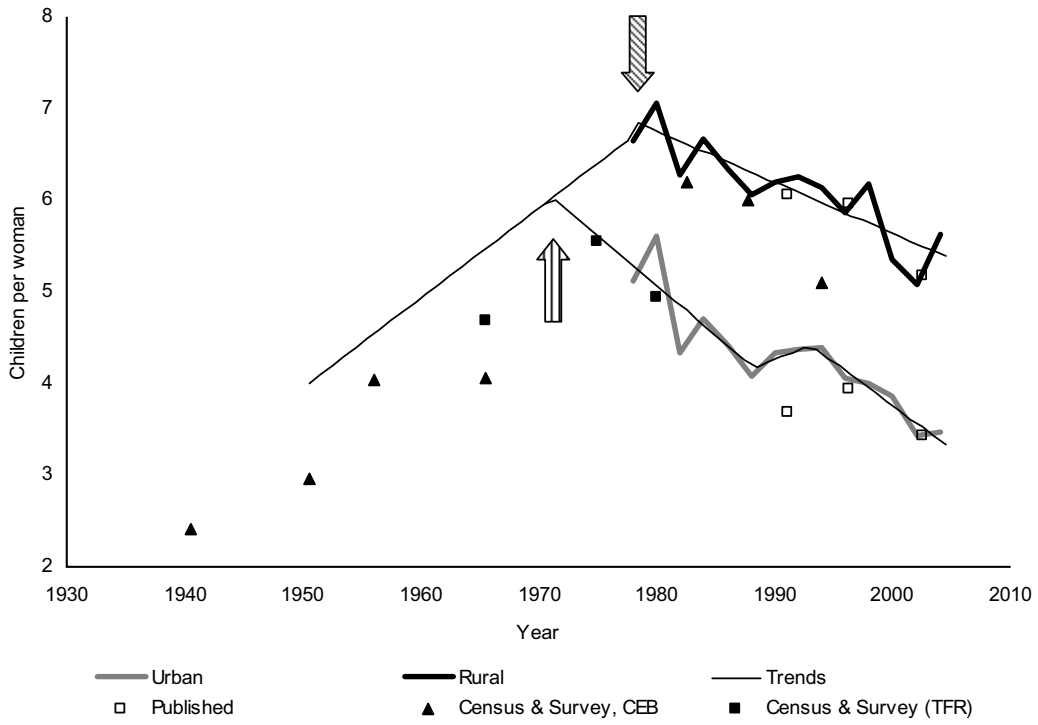
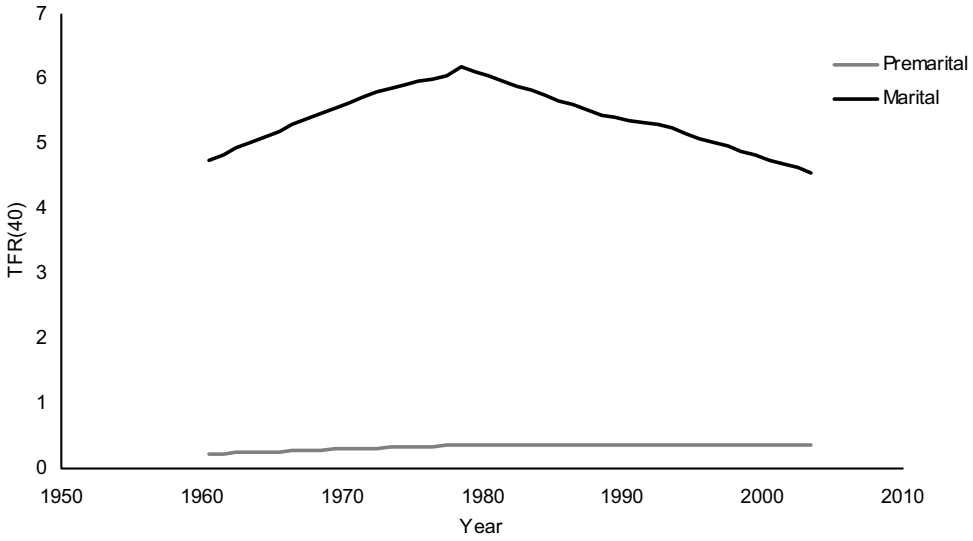


Figure B.18.2 Trends in Marital and Premarital Fertility, Madagascar, 1960-2003



Malawi

Malawi conducted DHS surveys in 1992, 2000, and 2004, covering 1977-2004. The results from all three surveys showed similar fertility levels and trends, and all indicate that the fertility level declined over the period covered.

Censuses conducted in 1977, 1987, and 1998, as well as surveys conducted in 1982, 1984, and 1996 provide additional evidence on CEB and TFR (Table B.19). Results from these censuses and surveys yield generally similar results. They indicate that the period fertility level before 1950 was high, around 6.3 children per woman (CFS of 7.0) and was stable or increased slightly in the 1950s and 1960s before reaching a peak at 7.0 in 1977; the 1992 DHS survey also found that TFR(40) was 7.0 in 1977.

Table B.19 Estimated fertility levels, Malawi, 1942-1994

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1977	CEB(60+)	1942.0	6.30	7.00
Census, 1977	CEB(50-59)	1952.0	6.35	7.06
Census, 1977	CEB(40)	1967.0	6.43	7.13
Survey, 1982	CEB(40)	1972.5	6.75	7.30
Survey, 1984	CEB(40)	1974.5	6.20	6.80
Census, 1987	CEB(60+)	1952.7	6.46	7.18
Census, 1987	CEB(50-59)	1962.7	6.55	7.28
Census, 1987	CEB(40)	1977.7	6.43	7.18
DHS, 1992	CEB(40)	1982.8	6.40	7.30
Survey, 1996	CEB(40)	1986.5	6.25	7.77
Census, 1998	CEB(70+)	1953.5	6.01	6.67
Census, 1998	CEB(60-69)	1963.5	6.10	6.77
Census, 1998	CEB(50-59)	1973.5	6.17	6.85
Census, 1998	CEB(40)	1988.5	5.88	6.66
DHS, 2000	CEB(40)	1990.7	6.10	7.00
DHS, 2004	CEB(40)	1994.9	5.97	6.83
Period fertility				
Census, 1977	TFR(40)	1976.5	5.64	6.86
Survey, 1982	TFR(40)	1982.0	5.58	6.63
Survey, 1984	TFR(40)	1982.5	6.52	7.58

The DHS survey results indicate that fertility trends in urban and rural were split in 1978, the first year covered by the DHS surveys and the year when Malawi's fertility decline began (Figure B.19.1). The negative slopes for both urban and rural areas and the differences between the slopes are highly significant ($p < 0.0001$).

The proportion of premarital births remained low, at 3.0 percent on average, and remained remarkably stable over the years. As a consequence, both premarital and marital fertility declined between 1978 and 2004, reaching a low 0.16 children per unmarried woman in 2004.

Figure B.19.1 Trends in Cumulated Fertility by Age 40, Malawi, 1950-2004

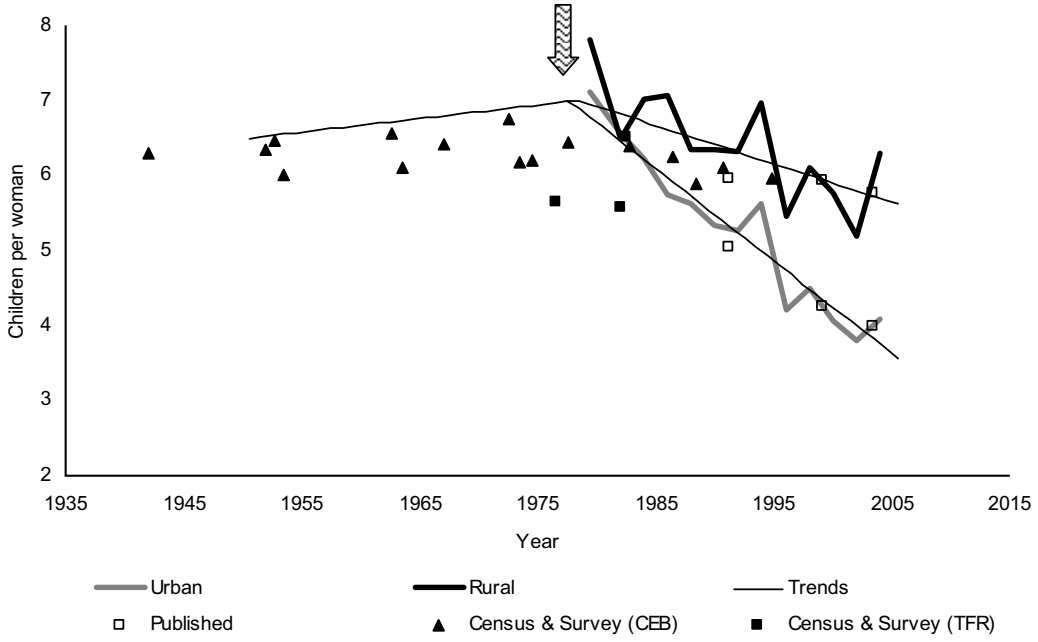
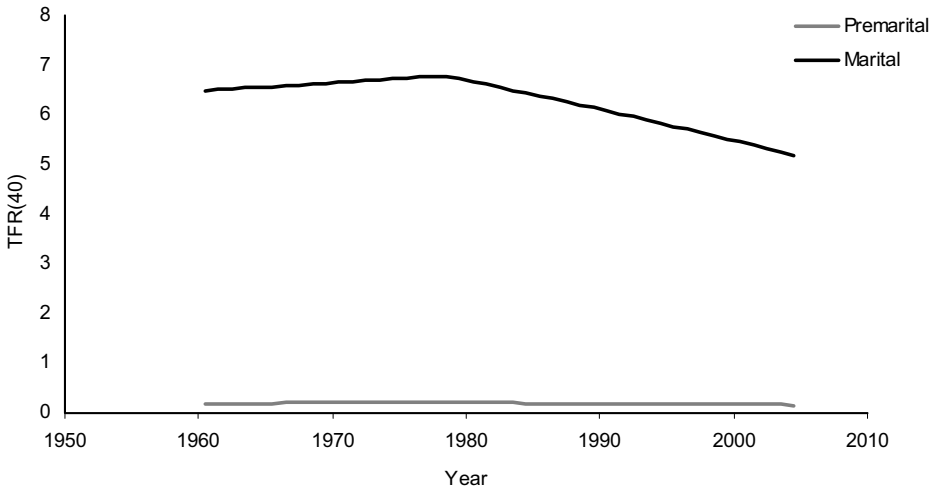


Figure B.19.2 Trends in Marital and Premarital Fertility, Malawi, 1960-2004



Mali

Mali conducted DHS surveys in 1987, 1996, and 2001, covering 1972-2001. The results for fertility levels and trends from all three surveys were similar and indicate that fertility rose in the early 1970s and then declined. However, the 1987 survey results showed lower fertility levels than the 1996 survey results in 1982-1985, a period covered by both surveys.

Data from a survey conducted in the rural areas in central Malawi in 1957 and the 1987 census provide additional evidence on fertility levels. The results from the 1957 survey are not nationally representative, but they indicate that the fertility level was approximately 5.2 in the late 1940s and that this level increased in the 1950s.

Table B.20 Estimated fertility levels, Mali, 1947-1986

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Central Niger Delta, 1957	CEB(40)	1947.0	5.17	5.44
Period fertility				
Central Niger Delta, 1957	TFR(40)	1957.0	6.04	6.68
Census, 1987	TFR(40)	1986.5	6.15	6.87

The DHS survey results indicate major discrepancies between fertility levels in urban and rural areas (Figure B.20.1). In urban areas, fertility remained constant between 1972 and 1986 ($p = 0.833$), then declined rapidly ($p < 0.0001$); the change in slope was highly significant ($p <00001$). In rural areas, fertility continued to increase between 1972 and 1990; the slope was strongly positive ($p <0.0001$). After 1990, fertility in rural areas began to decline rapidly, at a similar speed to urban areas ($p = 0.274$). The split between urban and rural areas occurred in approximately 1967. When the increasing fertility levels in rural areas were extrapolated backward, the resulting levels were similar to the estimates from the 1957 survey, providing additional evidence for the continuous increase in rural fertility over that period.

The proportion of premarital births remained very low between 1972 and 2001. However, the 1987 DHS survey results for premarital fertility are slightly different from the results of the 1996 and 2001 surveys. The later DHS survey results indicate a significant rise in the proportion of premarital births from 1.4 percent in 1972 to 2.8 percent in 2001. As a result, premarital fertility levels continued to increase over the period, reaching 0.16 children per woman in 2001, whereas the trend for marital fertility was similar to the overall trend in that marital fertility levels declined starting in approximately 1990 (Figure B.20.2)

Figure B.20.1 Trends in Cumulated Fertility by Age 40, Mali, 1947-2001

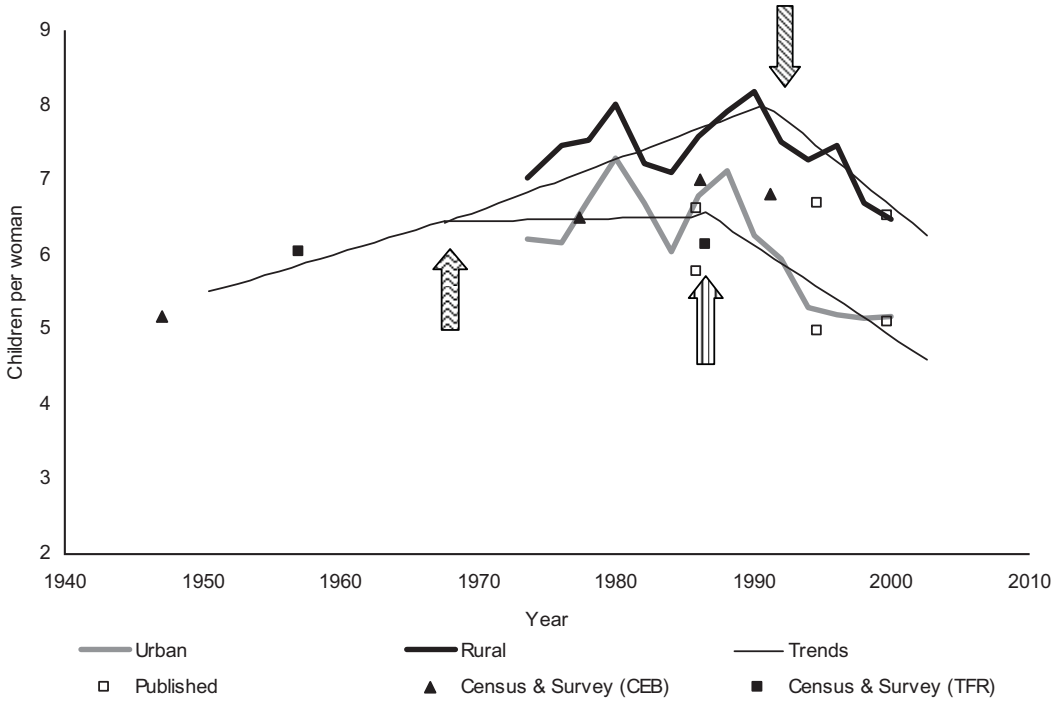
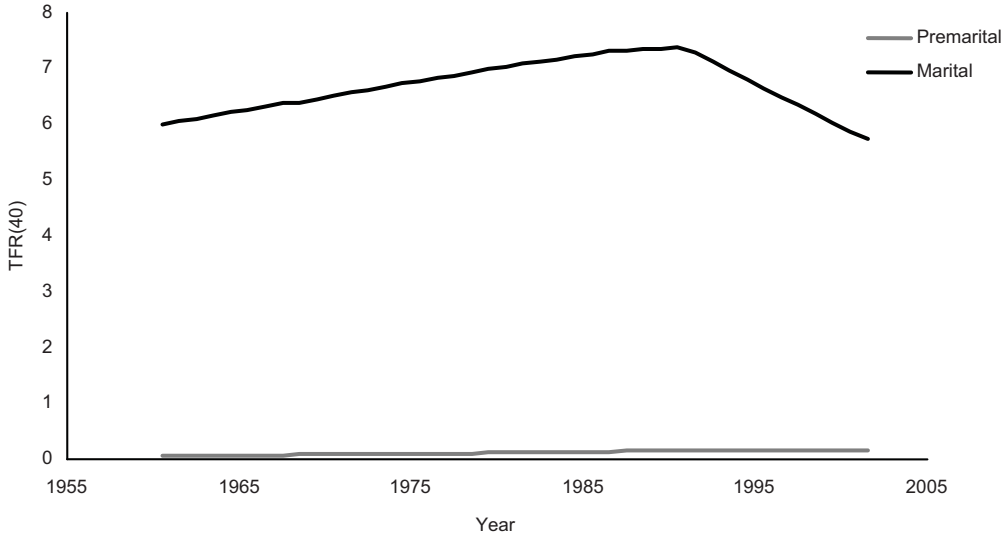


Figure B.20.2 Trends in Marital and Premarital Fertility, Mali, 1960-2001



Mozambique

Mozambique conducted DHS surveys in 1997 and 2003 covering 1982-2003. Results from both surveys indicated that fertility was declining during this period, although the 2003 survey results indicate a more rapid decline than the 1997 survey.

The censuses conducted in 1950, 1981, and 1997 provide additional data on fertility in Mozambique (Table B.21). The census results indicate that the TFR(40) in Mozambique was low before 1940, approximately 3.5 (CFS = 3.9), which is consistent with the level measured in 1950 and the subsequent rise. The results from the 1950-1997 censuses and the 1997 and 2003 DHS surveys indicate a major increase in fertility after 1950.

Table B.21 Estimated fertility levels, Mozambique, 1925-1987

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1950	CEB(50-59)	1925.7	3.53	3.99
Census, 1950	CEB(40)	1940.0	3.42	3.80
Census, 1997	CEB(50-59)	1972.6	5.05	5.62
Census, 1997	CEB(40)	1987.6	5.34	5.85
Period fertility				
Census, 1950	TFR(50)	1950.0	3.57	4.02
Census, 1981	TFR(50)	1981.0	5.84	6.49

The DHS data cover a period of declining fertility, when trends in urban and rural areas diverged (Figure B.21.1). In urban areas, the fertility rate slope was highly negative and highly significant ($p < 0.0001$) throughout 1982-2003. In rural areas, fertility continued to increase in 1982-1990 ($p = 0.001$). Rural fertility levels declined slightly between 1990 and 2003, although the change was not significantly different from 0 ($p = 0.605$); the change in slope was highly significant ($p = 0.004$). Urban fertility levels might have been slightly higher than rural fertility levels in the early 1980s, when overall fertility rates in Mozambique stopped increasing and started decreasing.

The proportion of premarital births remained at approximately 5.5 percent over the period covered by the DHS surveys and showed no discernible trend ($p = 0.262$). As a result, both premarital and marital fertility trends were similar to the national trend. The number of premarital births per woman was 0.26 in 2003.

Figure B.21.1 Trends in Cumulated Fertility by Age 40, Mozambique, 1950-2003

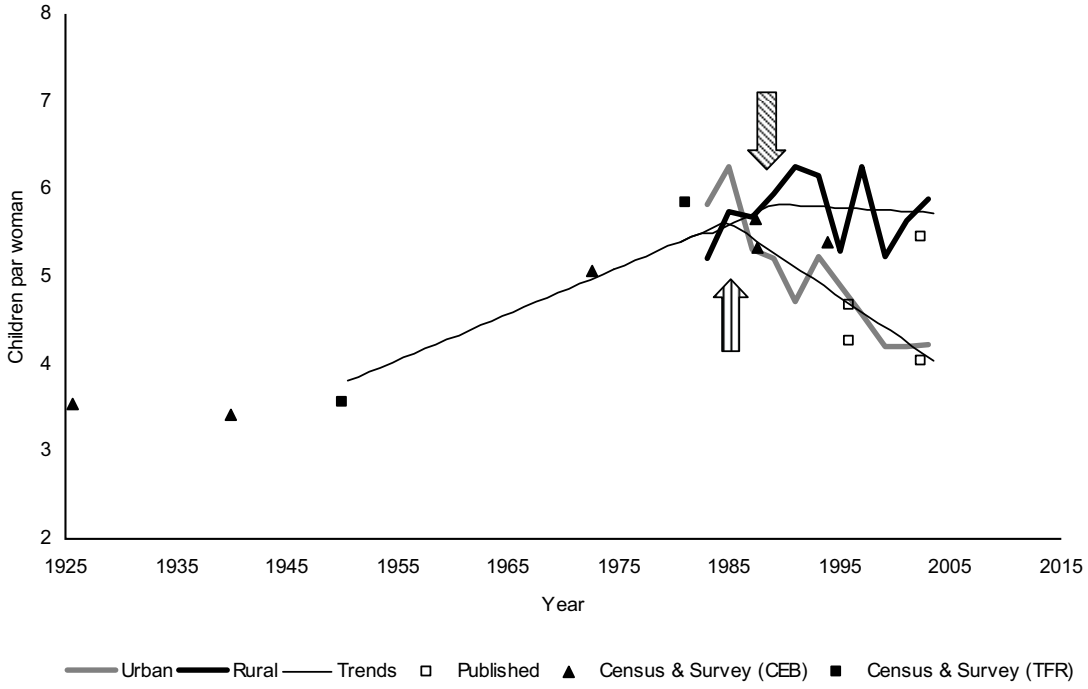
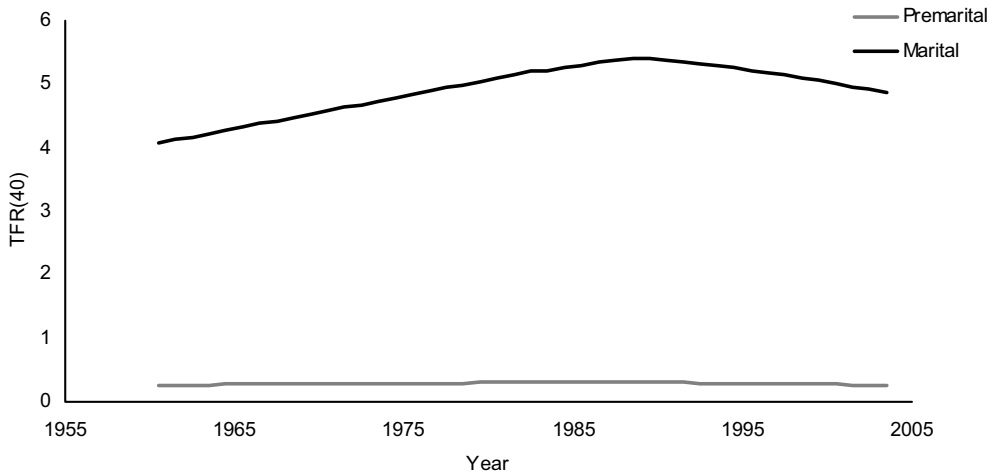


Figure B.21.2 Trends in Marital and Premarital Fertility, Mozambique, 1960-2003



Namibia

Namibia conducted DHS surveys in 1992 and 2000, covering 1977-2000. The results from both surveys concerning fertility levels and trends are similar and indicate a decline in fertility.

Other data on fertility are available from censuses conducted in 1981, 1991, and 2001 (Table B.22). A longitudinal analysis of data from parish registers from the former Ovamboland (northcentral Namibia) provides independent confirmation of the fertility levels and trends from the censuses (Shemeikka et al., 2005). The study of parish registers in Ovamboland shows similar fertility levels and trends to the DHS survey and the 1981-2001 censuses. According to the parish registers study results, fertility increased in the 1950s, reached a plateau in the mid-1970s, and declined rapidly thereafter in Ovamboland in a parallel fashion to Namibia's overall decline (Figure B.22.1).

Table B.22 Estimated fertility levels, Namibia, 1956-1991

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1991	CEB(60-69)	1956.8	5.34	5.94
Census, 1991	CEB(50-59)	1966.8	5.72	6.35
Census, 1991	CEB(40)	1981.8	5.10	6.08
Census, 2001	CEB(40)	1991.7	3.92	4.87
Period fertility				
Census, 1981	TFR(40)	1981.0	5.97	6.64

The results from the 1981 and 2001 censuses suggest that the period fertility level in rural areas was approximately 5 in 1950 and increased between 1950 and the mid-1970s. DHS survey results indicate a major drop in fertility in rural areas in 1975-2000, with a strongly negative slope ($p < 0.0001$). The slopes for urban and rural areas were not significantly different ($p = 0.409$), and a gap of about 15 years occurred between the two fertility declines (Figure B.22.1). The precise timing of the fertility decline onset in Namibia is difficult to assess from the limited data available. Assuming that the increase in period fertility was parallel to that of cohort fertility, the onset of the country's fertility decline seems to have occurred in the early 1960s in urban areas and in the mid-1970s in rural areas.

Premarital fertility is highly prevalent in Namibia. The proportion of premarital births has increased rapidly, from 30.0 percent in 1977 to 44.2 percent in 2000. The Ovamboland study results showed an increase in premarital fertility between 1977 and 2000. As a result of the increase in the proportion of premarital births, premarital fertility levels remained stable during this period, at an average of 1.7 children per women. In contrast, the marital fertility level decreased dramatically. The premarital and marital fertility levels were essentially equivalent by 2000 (Figure B.22.2).

Figure B.22.1 Trends in Cumulated Fertility by Age 40, Namibia, 1950-2000

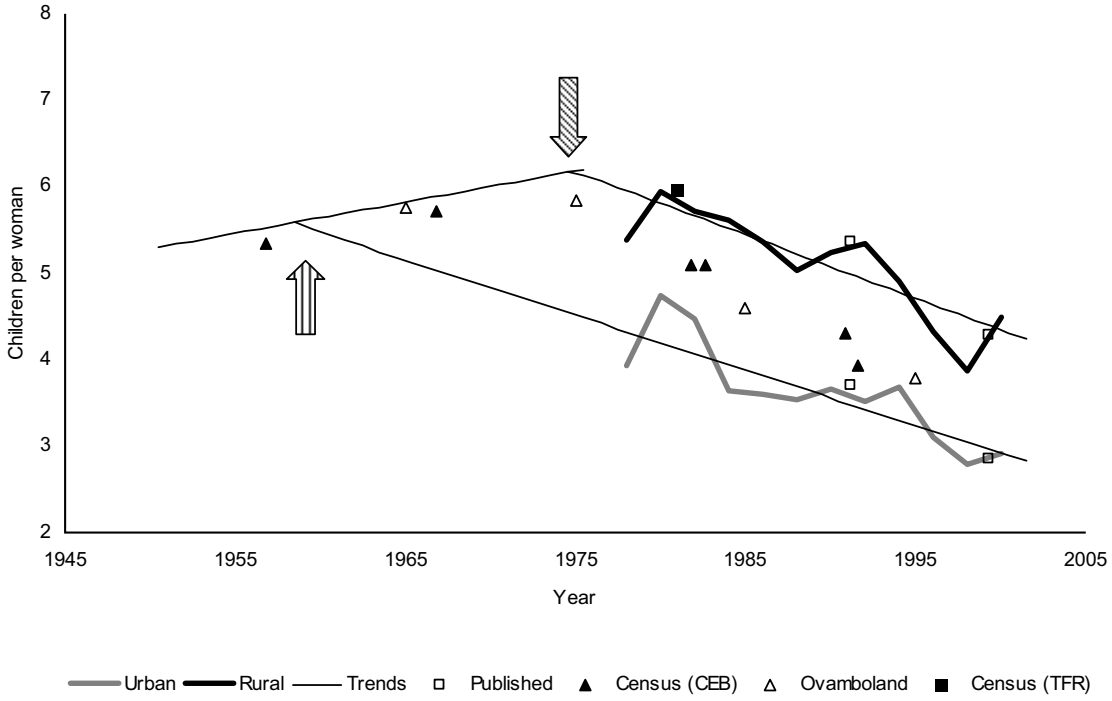
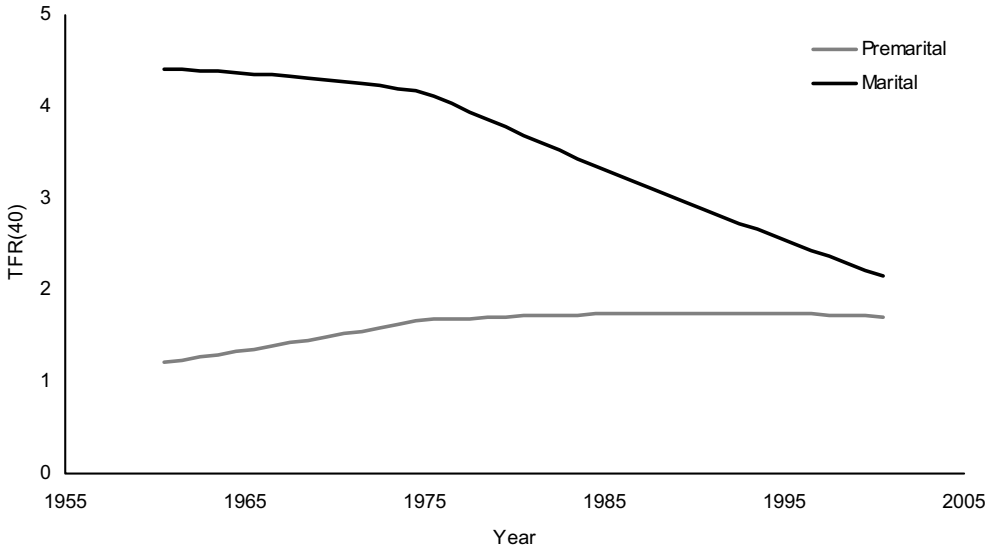


Figure B.22.2 Trends in Marital and Premarital Fertility, Namibia, 1960-2000



Niger

Niger conducted DHS surveys in 1992 and 1998, covering 1977-1998. The results of both surveys showed similar fertility levels and trends; these levels were initially high and declined slowly.

A survey was conducted in Niger's sedentary population in 1960 and in the country's nomadic population in1963. The results of this survey and Niger's 1988 census provide additional data on fertility levels and trends (Table B.23). These data indicate a steady TFR(40) level before 1950, at approximately 5.0 children per woman for the sedentary population and 4.2 in the nomadic population. The results from the surveys and census also indicate a substantial rise in fertility in the 1950s and 1960s.

Table B.23 Estimated fertility levels, Niger, 1914-1987

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1960 (sedentary population)	CEB(70+)	1914.8	4.81	5.34
Survey, 1960 (sedentary population)	CEB(60-69)	1924.8	5.01	5.57
Survey, 1960 (sedentary population)	CEB(50-59)	1934.8	5.08	5.65
Survey, 1960 (sedentary population)	CEB(40)	1949.8	4.94	5.82
Survey, 1963 (nomadic population)	CEB(50+)	1938.6	3.83	4.26
Survey, 1963 (nomadic population	CEB(40)	1953.6	4.58	4.99
Census, 1988	CEB(40)	1978.4	5.94	6.40
Period fertility				
Survey, 1960 (sedentary population)	TFR(40)	1959.3	6.54	7.27
Survey, 1963 (nomadic population)	TFR(40)	1963.1	5.55	6.44
Census, 1988	TFR(40)	1987.9	6.57	7.21

The DHS data cover the peak fertility period in Niger, with an estimated TFR(40) as high as 8.2 [corresponding to TFR(50) of 9.1] in 1975. After reaching this peak, the fertility level decreased dramatically in both urban and rural areas (Figure B.23.1). Both slopes were strongly negative between 1977 and 1998 ($p < 0.00001$ for both slopes); the absolute value of the urban fertility level slope was higher than that of the rural fertility slope ($p < 0.00001$). The urban and rural fertility trends intersected in 1975, when the fertility decline began in both regions.

The proportion of premarital births in Niger was very low, although it increased from 0.4 percent in 1977 to 0.8 percent in 1998. As a result, the pattern of marital fertility was similar to that of the general population (Figure B.23.2).

Figure B.23.1 Trends in Cumulated Fertility by Age 40, Niger, 1950-1998

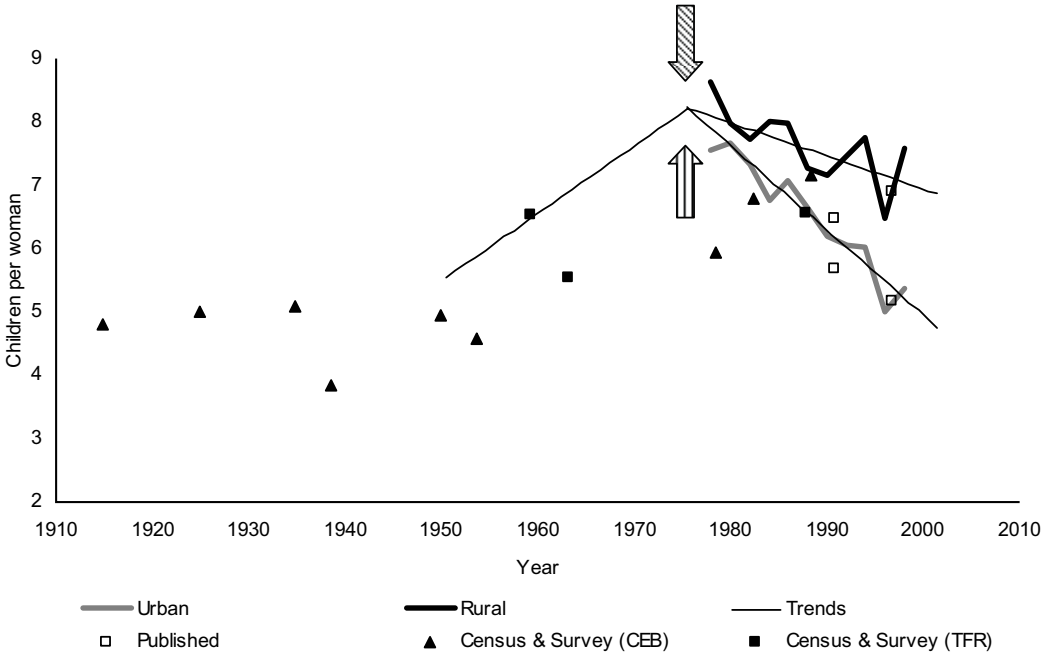
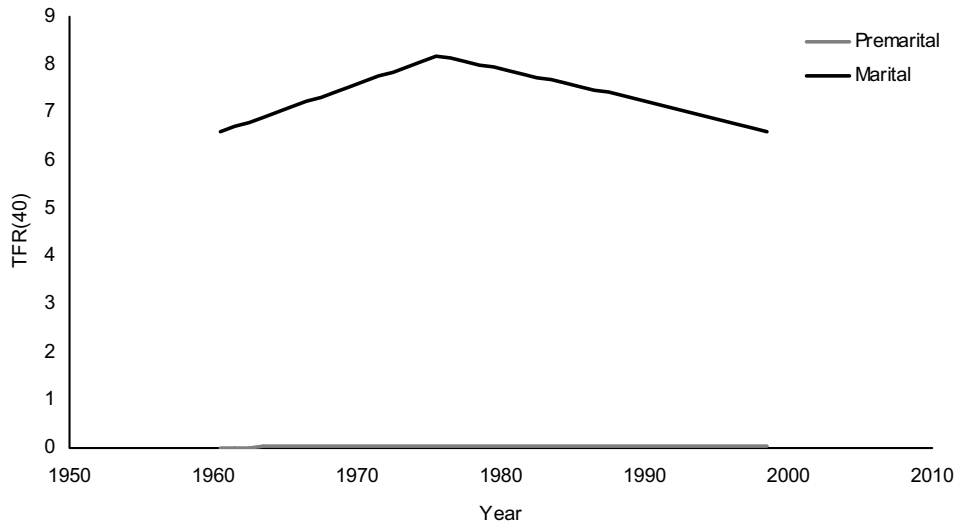


Figure B.23.2 Trends in Marital and Premarital Fertility, Niger, 1960-1998



Nigeria

Nigeria conducted a WFS survey in 1982 and DHS surveys in 1990, 1999, and 2003, covering 1967-2003. The results of the four surveys concerning fertility levels and trends were similar and showed an increasing level in the 1970s followed by a decline, then a stall in 1999-2003. However, the rates from the 1982 WFS survey results for 1980-1981 were lower than the rates from the DHS survey and the 1996-1997 rates from the 1999 DHS survey were lower than the results from the 2003 DHS survey.

Data from the 1965-1966 National Rural Demographic Survey and the 1994 National Sentinel Survey complement the DHS survey data (Table B.24). Access to the original data was not available but information on these data was available from a publication by Feyisetan and Bankole (2002). The available evidence suggest that the average period fertility rate in Nigeria in the 1950s was approximately 5.0 children per woman at age 40 (CFS = 5.6).

Table B.24 Estimated fertility levels, Nigeria, 1955 and 1993

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
National Rural Demographic Survey, 1965-66	CEB(50)	1955	5.04	5.6
Period fertility				
National Sentinel Survey, 1994	TFR(50)	1993	4.86	5.4

The WFS and DHS survey results show similar trends in and a similar gap between urban and rural fertility levels (Figure B.24.1). In urban areas, the fertility level increased from 1977 to 1980; the slope was significantly positive ($p = 0.008$). The fertility level in urban areas then decreased from 1980 to 1999, with a highly significant negative slope ($p < 0.00001$). The urban fertility level stalled or increased slightly between 1999 and 2003; the slope was positive ($p = 0.031$). The changes in slope for the turning points in 1980 and 1999 were highly significant ($P < 0.00001$ for 1980 and $P = 0.003$ for 1999).

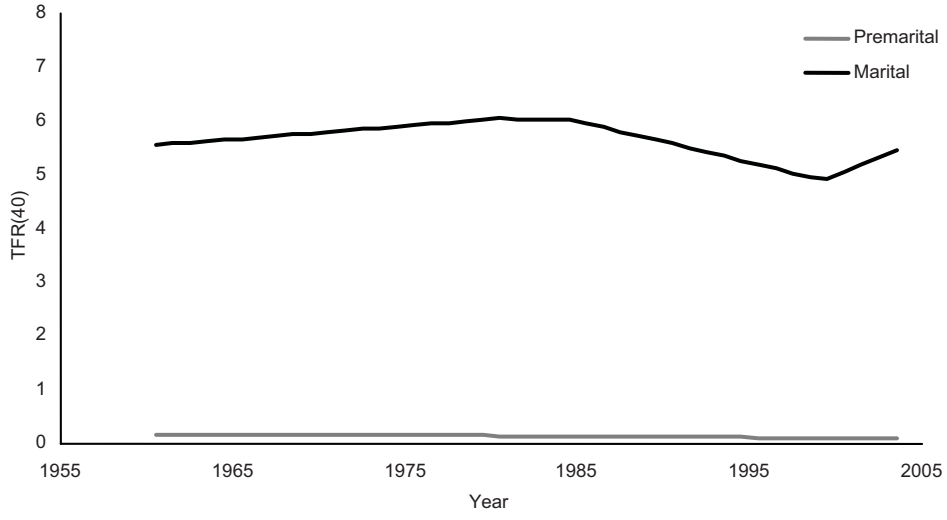
Fertility levels in rural areas increased between 1967 and 1984, decreased from 1984 to 1999, and increased again between 1999 and 2003. All slopes were significantly different from 0 ($p = 0.018$ for 1967-1984, $p < 0.00001$ for 1984-1999, and $p = 0.0004$ for 1999-2003), and the changes in slopes at turning points (1984 and 1999) were highly significant ($p < 0.00001$ for both changes in slope).

The trends in urban and rural areas were parallel between 1967 and 2003, and urban fertility levels were already lower than rural fertility levels in the 1960s. When the trends from 1967 were extrapolated backward to the early 1980s, the results matched the estimates for the early 1950s, providing additional evidence for the consistency of the data on urban and rural fertility levels and trends.

The premarital fertility level in Nigeria remained low throughout the period covered by the DHS and WFS surveys (0.14 children per woman on average) and the proportion of premarital births declined from 2.7 percent in 1967 to 2.1 percent in 2003. Even when overall fertility rates were rising (1967-1980), premarital fertility levels in Nigeria were already declining and these rates did not increase during the country's fertility stall (1999-2003). The marital fertility trend was similar to the trend for the general population (Figure B.24.2).

Figure B.24.1 Trends in Cumulated Fertility by Age 40, Nigeria, 1950-2003

Figure B.24.2 Trends in Marital and Premarital Fertility, Nigeria, 1960-2003



Rwanda

Rwanda conducted a WFS survey in 1983 and DHS surveys in 1992, 2000, and 2005, covering 1977-2005. The results of the four surveys showed similar fertility levels and trends. All of the surveys indicated a plateau, followed by a decline and then another plateau.

Data on fertility are also available from a survey conducted in 1970 and censuses conducted in 1978 and 1990 (Table B.25). These data indicate that TFR(40) was high, approximately 5.9 (CFS = 6.5), before 1950 and subsequently increased.

Table B.25 Estimated fertility levels, Rwanda, 1935-1991

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1970	CEB(60-69)	1935.7	5.90	6.55
Survey, 1970	CEB(50-59)	1945.7	5.83	6.48
Survey, 1970	CEB(40)	1960.7	6.40	6.53
Census, 1978	CEB(40)	1968.6	6.87	7.64
Period fertility				
Survey, 1970	TFR(40)	1970.2	6.84	7.66
Census, 1978	TFR(40)	1978.1	7.21	8.66
Census, 1990	TFR(40)	1991.0	4.72	5.55

The WFS and DHS survey results show rising fertility levels for the country as a whole, followed by divergent trends between urban and rural areas (Figure B.25.1). In urban areas, the fertility level decreased steadily after 1968 (significant slope, $p < 0.00001$) and was markedly low in the early 1990s according to all three DHS surveys covering this period. In rural areas, the slope increased between 1968 and 1982 (borderline significance, $p = 0.081$), then decreased from 1982 to 1999 ($p < 0.00001$); this was followed by a fertility stall between 1999 and 2005 ($p = 0.324$). All changes in slope for rural areas were highly significant ($p < 0.0001$ for the change before and after 1982 and $p = 0.011$ for the change before and after 1999). The fertility decline between 1992 and 1999 was more rapid in rural areas than urban areas ($p < 0.0001$).

Rwanda's civil war (the genocide) in 1994 was not associated with any marked decline in fertility. This could be due to selection bias (families who were exterminated could not be counted in later censuses and surveys), the effect of sexual abuse and rape, or immigration by former refugees. This issue deserves further research.

Premarital fertility was extremely low in Rwanda, although it increased rapidly. The proportion of premarital births increased from 0.4 percent in 1968 to 4.2 percent in 2005, a 10-fold increase. Premarital fertility was high during the crisis years (1991-1997) and again in 2001-2005. However, in absolute terms, premarital fertility remained low, reaching 0.2 children per women in children per women in 2005. Trends in marital fertility were similar to those for the general population (Figure B-25.2).

Figure B.25.1 Trends in Cumulated Fertility by Age 40, Rwanda, 1950-2005

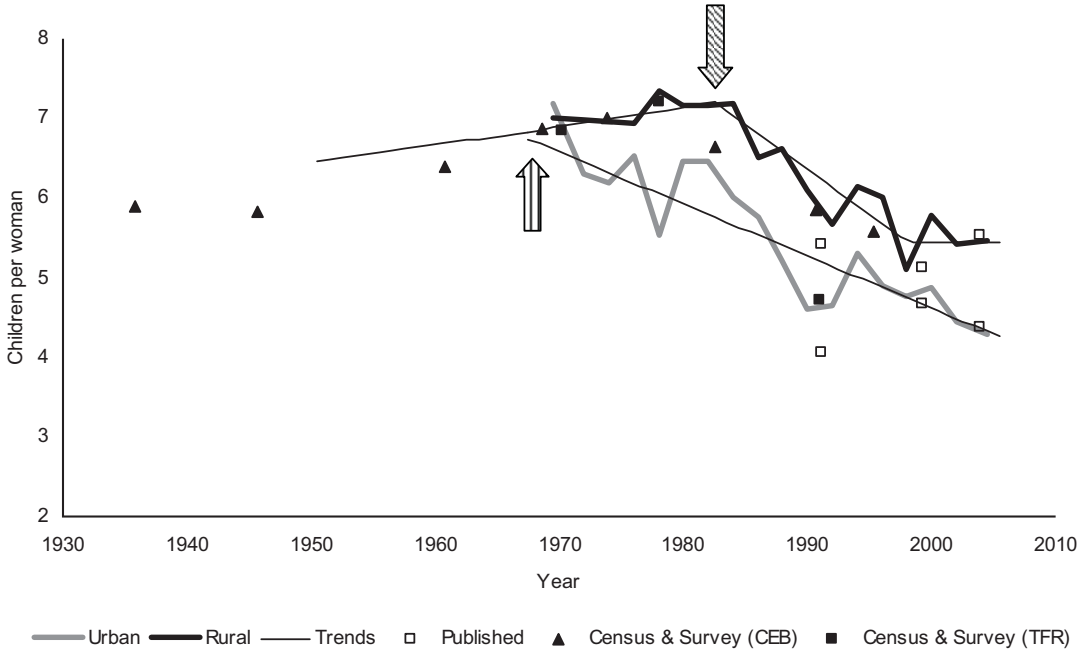
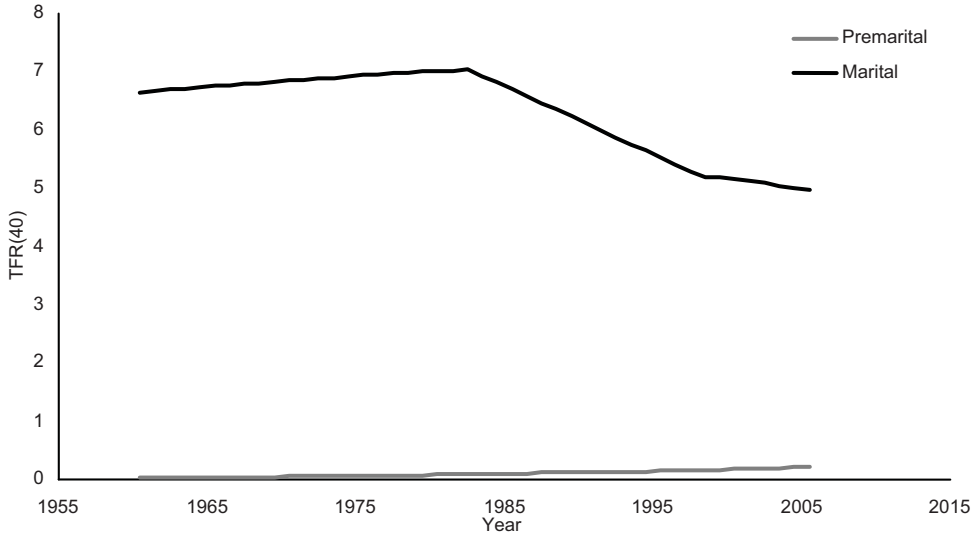


Figure B.25.2 Trends in Marital and Premarital Fertility, Rwanda, 1960-2005



Senegal

Senegal conducted a WFS survey in 1978 and DHS surveys in 1986, 1993, 1997, and 2005; these surveys covered 1963-2005. The results from these surveys showed similar fertility levels and trends. According to these results, fertility reached a high plateau before declining.

Surveys conducted in 1960, 1970, and 1979 provide additional data on fertility levels. Data from the Senegal River valley survey in 1957 and the Niakhar and Ngayokheme demographic surveillance systems surveys, which cover 1963-2005, were also used (Table B.26). These results indicate that Senegal's cohort fertility level was approximately 5.0 prior to 1950 and increased in the 1950s and 1960s. Fertility levels in the Senegal River valley, a rural area in the north, rose from 1947 to 1957. The results from the Ngayokheme and Niakhar demographic surveillance systems surveys show that fertility levels in these regions were higher in the 1960s than in other parts of the country and these levels increased until 1986 before dropping. However, the fertility level in this region was lower in 1973-1977, when Ngayokheme and Niakhar experienced a drought.

Table B.26 Estimated fertility levels, Senegal, 1947-1998

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1960	CEB(40)	1950.3	4.73	5.41
Senegal River Valley Survey, 1957	CEB(40)	1947.0	5.17	4.79
Period fertility				
Survey, 1960	TFR(40)	1959.8	5.00	5.37
Survey, 1970	TFR(40)	1971.1	5.60	6.46
Survey 1979	TFR(40)	1979.0	7.26	8.07
Senegal River Valley Survey, 1957	TFR(40)	1957.0	5.60	6.22
Demographic surveillance systems				
Ngayokheme, 1963-1967	TFR(40)	1965.5	6.27	7.02
Ngayokheme, 1968-1972	TFR(40)	1970.5	6.43	7.05
Ngayokheme, 1973-1977	TFR(40)	1975.5	6.20	6.89
Ngayokheme, 1978-1982	TFR(40)	1980.5	6.53	7.12
Niakhar, 1984-1987	TFR(40)	1986.0	7.03	7.87
Niakhar, 1988-1991	TFR(40)	1990.0	6.89	7.74
Niakhar, 1992-1995	TFR(40)	1994.0	6.49	7.27
Niakhar, 1996-1999	TFR(40)	1998.0	6.18	6.85

The results of the WFS and DHS surveys reveal differences in trends between urban and rural areas (Figure B.26.1). In urban areas, fertility declined slowly between 1963 and 1980; the slope was not significantly different from 0 ($p = 0.311$). Thereafter, urban fertility dropped rapidly ($p < 0.00001$); the difference in slopes was significant ($p = 0.004$). In rural areas, fertility levels increased from 1963 to 1982 ($p = 0.0003$), then decreased substantially until 2005, the last year for which data are available; the slope was highly significant ($p < 0.00001$).

The proportion of premarital births increased from 1.3 percent in 1963 to 3.5 percent in 1992 before decreasing to 1.5 percent in 2005. As a result, premarital fertility levels also increased and then decreased, whereas the trend for marital fertility was similar to the trend for the general population (Figure B.26.2).

Figure B.26.1 Trends in Cumulated Fertility by Age 40, Senegal, 1950-2005

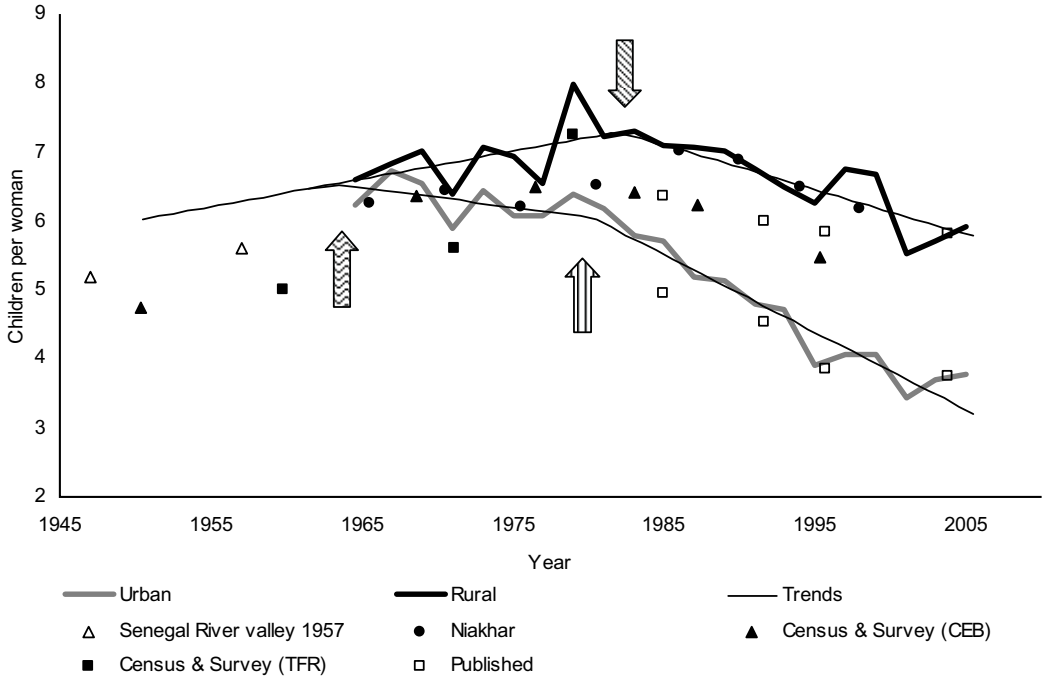
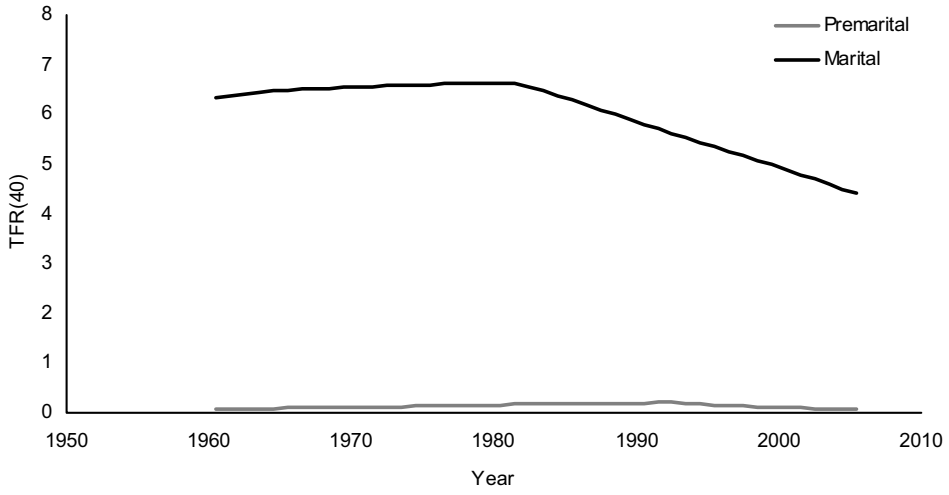


Figure B.26.2 Trends in Marital and Premarital Fertility, Senegal, 1960-2005



Tanzania

Tanzania conducted DHS surveys in 1991, 1996, 1999, and 2004, covering 1976-2004. The results for fertility levels and trends from all four surveys were similar. In general, these results indicated a declining trend in 1976-2004.

Data from censuses conducted in 1967, 1978, and 1988 provide additional evidence on fertility levels and trends (Table B.27). These data indicate that the TFR(40) was approximately 4.4 prior to 1950 (CFS = 4.9) and increased thereafter.

Table B.27 Estimated fertility levels, Tanzania, 1932-1988

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1967	CEB(60+)	1932.6	4.36	4.84
Census, 1967	CEB(50-59)	1942.6	4.50	5.00
Census, 1967	CEB(40)	1957.6	4.76	5.05
Period fertility				
Census, 1978	TFR(40)	1978.0	6.39	7.09
Census, 1988	TFR(40)	1988.0	5.87	6.48

The DHS survey results indicate declining fertility levels in both urban and rural areas (Figure B.27.1). In urban areas, the fertility level declined more rapidly from 1977 to 1995 ($p < 0.00001$) and more slowly from 1995 to 2004, when the slope was only slightly lower than 0, with borderline significance ($p = 0.075$). In rural areas, fertility also declined from 1977 to 1995 ($p < 0.00001$); however, the fertility level in rural areas stalled in 1995 to 2004 ($p = 0.909$). The changes in slope for both urban and rural areas were significant ($p = 0.001$ for urban areas, $p = 0.021$ for rural areas). The fertility decline was more rapid in urban areas than rural areas between 1977 and 1995 ($p < 0.00001$), and the slopes for the two areas were not significantly different after 1995 ($p = 0.152$).

Premarital fertility is common in Tanzania, with an average proportion of premarital births of approximately 6.0 percent over the period studied. This proportion tended to increase from 4.0 percent in 1977 to 7.0 percent in 1988 and then decreased thereafter. Premarital fertility levels were higher and increased later than fertility in the general population, whereas trends in marital fertility were similar to trends for the general population (Figure B.27.2).

Figure B.27.1 Trends in Cumulated Fertility by Age 40, Tanzania, 1950-2003

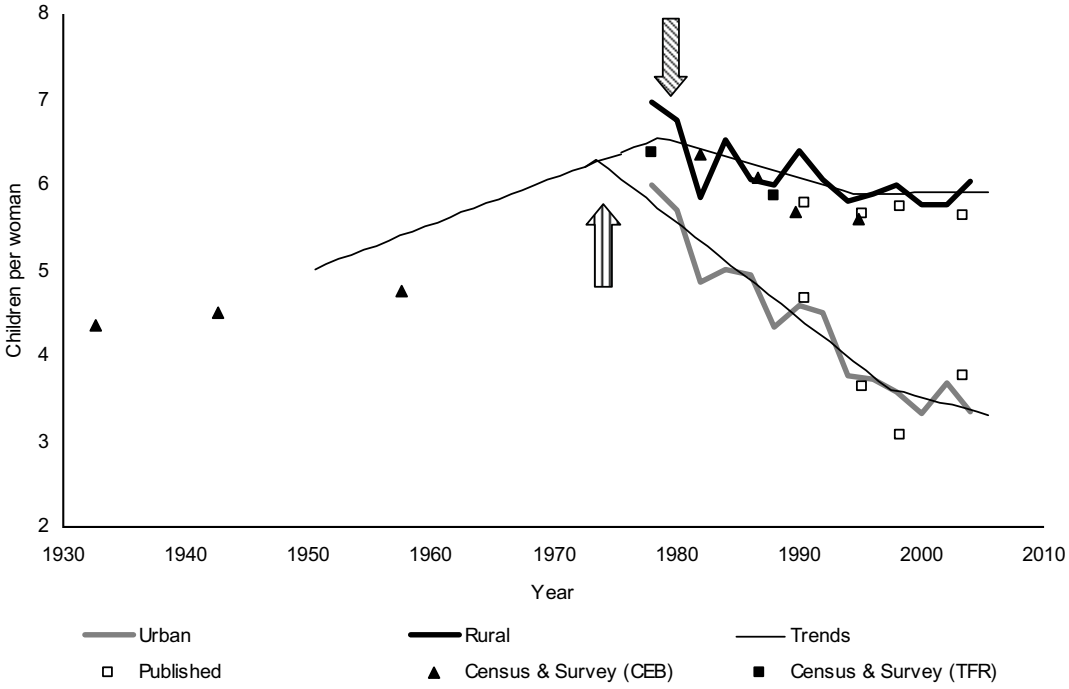
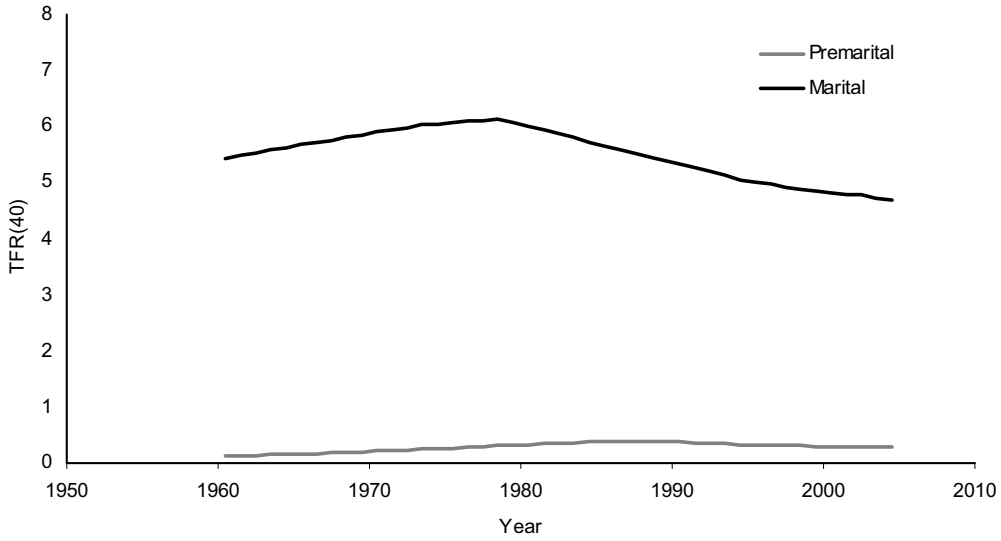


Figure B.27.2 Trends in Marital and Premarital Fertility, Tanzania, 1960-2003



Togo

Togo conducted DHS surveys in 1988 and 1998, covering 1973-1998. The results of these surveys showed similar fertility levels and trends; both indicate that fertility levels declined over the period covered.

Data from a survey conducted in 1961 and two censuses conducted in 1971 and 1981 provide additional evidence on fertility trends in Togo. These data indicate that the TFR(40) in Togo averaged approximately 5.4 (CFS = 6.0) prior to 1950 and increased thereafter.

Table B.28 Estimated fertility levels, Togo, 1936-1981

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Survey, 1961	CEB(50+)	1936.0	5.38	5.98
Survey, 1961	CEB(40)	1951.0	5.50	5.94
Census, 1971	CEB(40)	1961.5	5.21	5.68
Census, 1981	CEB(40)	1971.5	5.51	6.00
Period fertility				
Survey, 1961	TFR(40)	1960.5	6.28	7.06
Census, 1971	TFR(40)	1971.0	4.93	5.74
Census, 1981	TFR(40)	1981.0	5.27	6.02

The results from the DHS surveys indicate that fertility trends in urban and rural areas diverged (Figure B.28.1). In urban areas, fertility declined substantially throughout the period covered by the surveys; the slope was highly significant ($p < 0.00001$). In rural areas, fertility continue to increase slowly from 1973 to 1980, although the slope was not significantly different from 0 for the few years covered ($p = 0.648$). After 1980, fertility in rural areas declined dramatically; the slope was highly significant ($p < 0.0001$) but the decline was not as rapid as in urban areas ($p = 0.005$).

The premarital fertility level in Togo remained low and tended to decline over time (Figure B.28.2).

Figure B.28.1 Trends in Cumulated Fertility by Age 40, Togo, 1950-1998

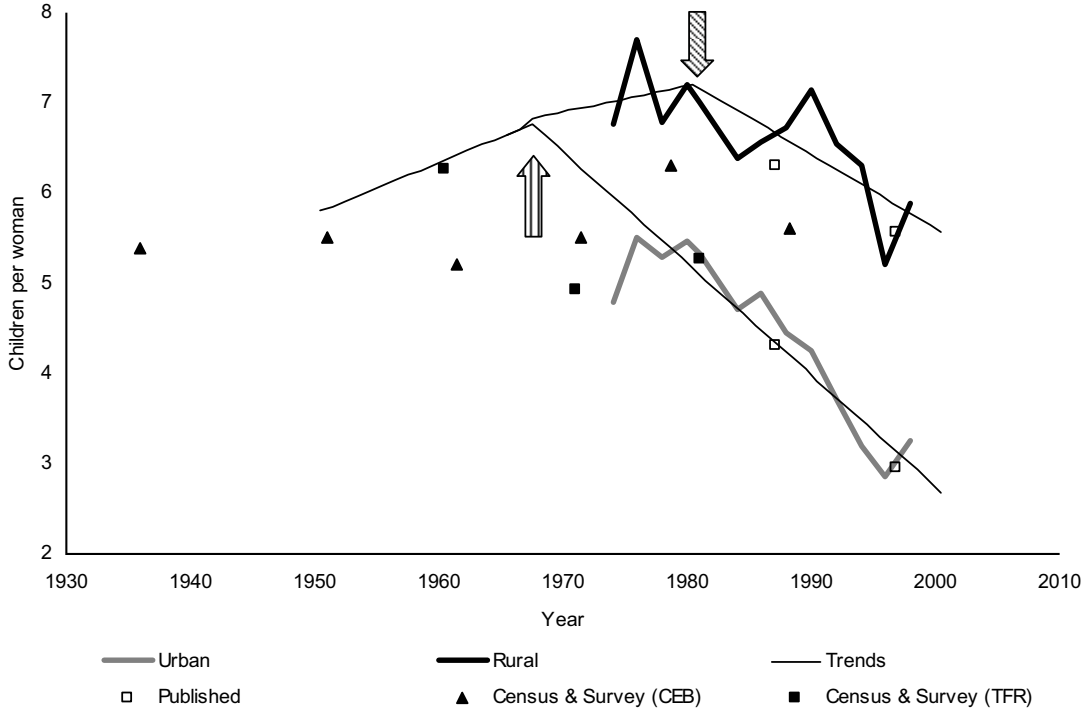
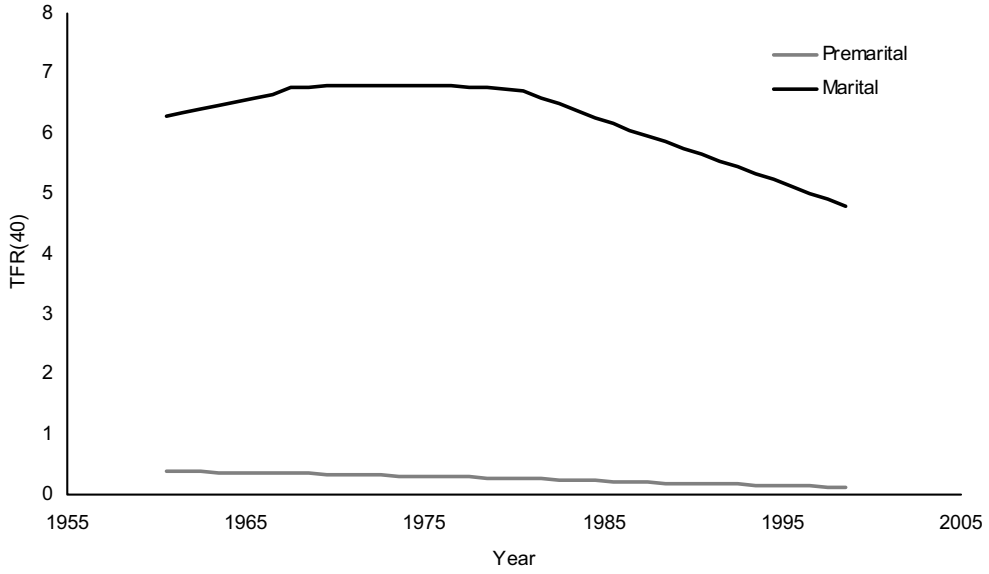


Figure B.28.2 Trends in Marital and Premarital Fertility, Togo, 1960-1998



Uganda

Uganda conducted DHS surveys in 1988, 1995, and 2001, covering 1973-2001. The results from all three showed similar fertility levels and trends, although the 2001 survey results showed somewhat higher levels in 1991-1994 than the 1995 survey. All of the DHS survey results showed that fertility declined slowly during the period covered.

Data from censuses conducted in 1959, 1969, and 1991 provide additional evidence on fertility levels and trends in Uganda (Table B.29). The results from these censuses indicate that the cohort fertility level was approximately 5.3 before 1950. However, the data on the fertility level in 1950 from the 1959 and 1969 census results appear to be inconsistent.

Table B.29 Estimated fertility levels, Uganda, 1959-1991

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1969	CEB(60+)	1934.6	4.23	4.70
Census, 1969	CEB(50-59)	1944.6	4.29	4.76
Census, 1969	CEB(40)	1959.6	4.99	5.05
Census, 1991	CEB(80+)	1936.0	5.28	5.86
Census, 1991	CEB(70-79)	1946.0	5.31	5.90
Census, 1991	CEB(60-69)	1956.0	5.63	6.26
Census, 1991	CEB(50-59)	1966.0	6.18	6.86
Census, 1991	CEB(40)	1981.0	6.59	7.10
Period fertility				
Census, 1959	TFR(40)	1959.1	4.95	5.42
Census, 1969	TFR(40)	1969.1	4.90	5.40
Census, 1991	TFR(40)	1990.5	6.09	6.66

The DHS survey results indicate a steady decline in fertility in both urban and rural areas after 1988 (Figure B.29.1). Both slopes are significantly lower than 0 ($p < 0.0001$ for urban areas and $p = 0.001$ for rural areas). The slope for urban areas had a much higher absolute value than the slope for rural areas ($p < 0.00001$).

Premarital fertility remained at a low and steady level (0.3 children per women) in Uganda. Premarital fertility played a small role in the overall population's fertility level, given the high marital fertility rate (6.1 in 2000) (Figure B.29.2).

Figure B.29.1 Trends in Cumulated Fertility by Age 40, Uganda, 1950-2001

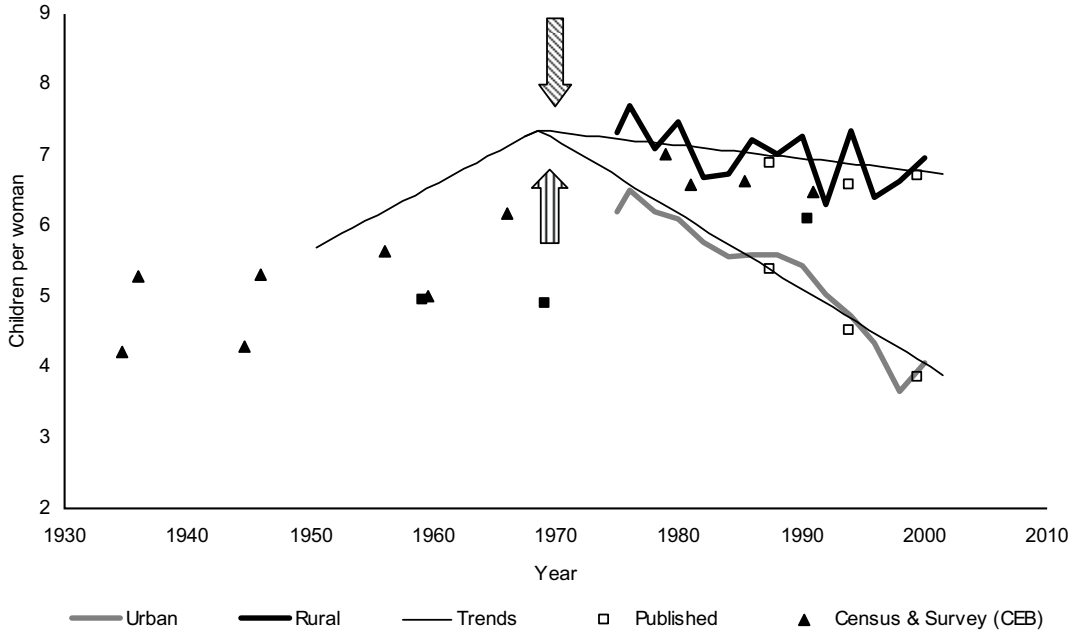
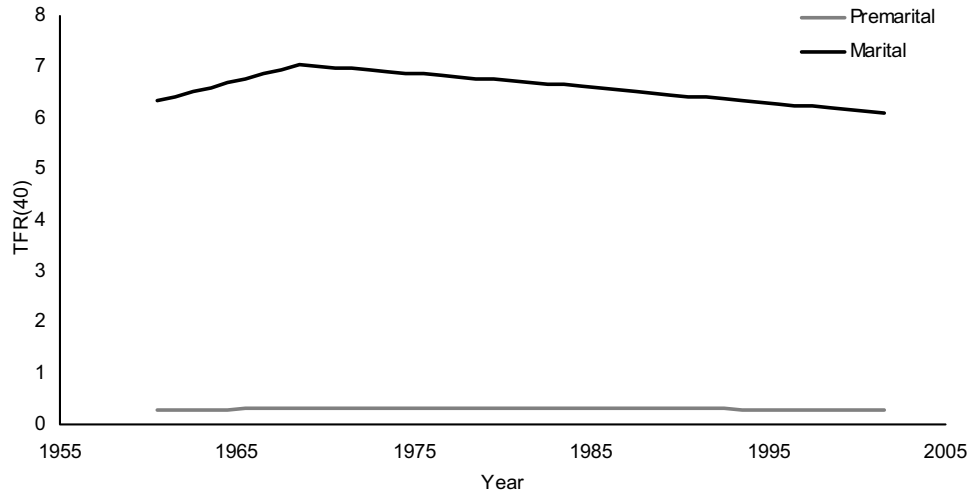


Figure B.29.2 Trends in Marital and Premarital Fertility, Uganda, 1960-2001



Zambia

Zambia conducted DHS surveys in 1992, 1996, and 2001, covering 1977-2001. The results from the three surveys show similar fertility levels and trends, and all indicate a steady decline over the period covered.

Data from censuses conducted in 1969, 1980, 1990, and 2000 provide additional data on fertility levels and trends (Table B.30). The results from these censuses indicate that the cohort fertility level might have been as low as 4 prior to 1940 before increasing steadily to reach a peak level in the mid-1970s.

Table B.30 Estimated fertility levels, Zambia, 1969-2000

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Cohort fertility				
Census, 1969	CEB(60-64)	1939.6	3.86	4.29
Census, 1969	CEB(50-59)	1944.6	4.16	4.63
Census, 1969	CEB(40)	1959.6	5.12	4.99
Census, 1990	CEB(60-69)	1955.6	5.03	5.59
Census, 1990	CEB(50-59)	1965.6	6.02	6.68
Census, 1990	CEB(40)	1980.6	6.44	7.15
Census, 2000	CEB(40)	1990.8	5.90	6.80
Period fertility				
Census, 1980	TFR(40)	1980.0	4.79	5.68

The period covered by DHS data began immediately after the fertility level in Zambia had already peaked (Figure B.30.1). These data indicate a steady fertility decline in both urban and rural areas since 1977; both slopes were highly significant ($p < 0.00001$). The slopes for fertility in urban and rural areas intersected in 1973 at a high CEB(40) of 7.4 [TFR(40) = 8.2]. The urban fertility slope rose more rapidly than the rural fertility slope ($p < 0.00001$).

The proportion of premarital births was low in Zambia at the beginning of the period covered by the DHS surveys and increased rapidly from 3.5 percent in 1977 to 7.8 percent in 2001 ($p < 0.00001$). As a result, the premarital fertility level increased steadily over the period, reaching 0.4 children per woman in 2001, whereas marital fertility levels and trends were similar to those for the general population (Figure B.30.2).

Figure B.30.1 Trends in Cumulated Fertility by Age 40, Zambia, 1950-2001

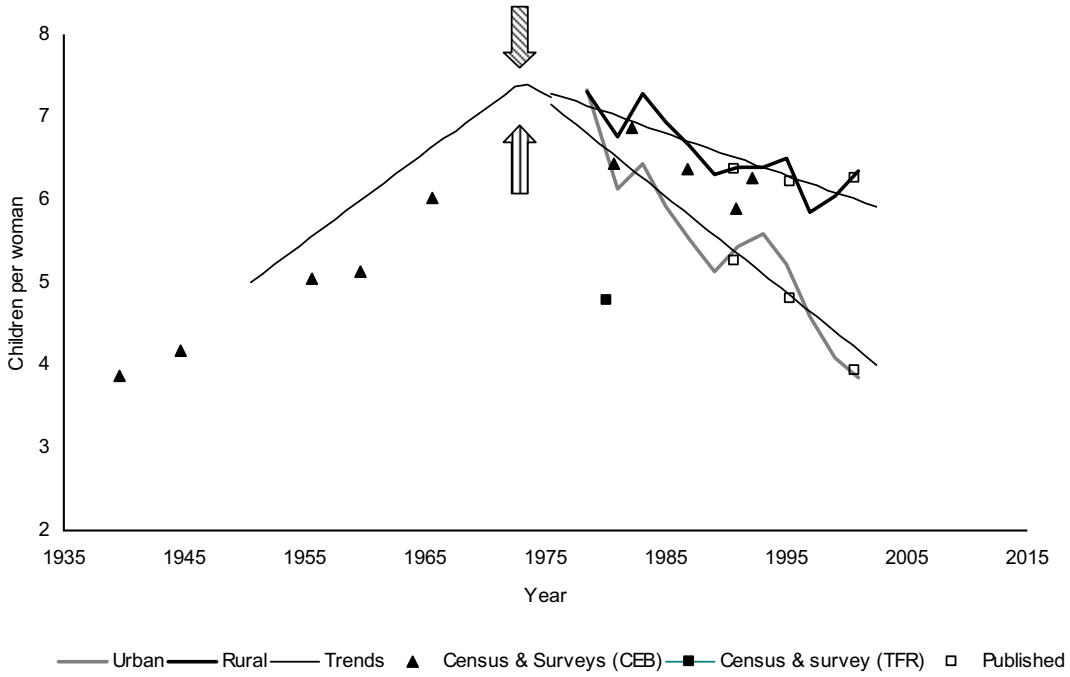
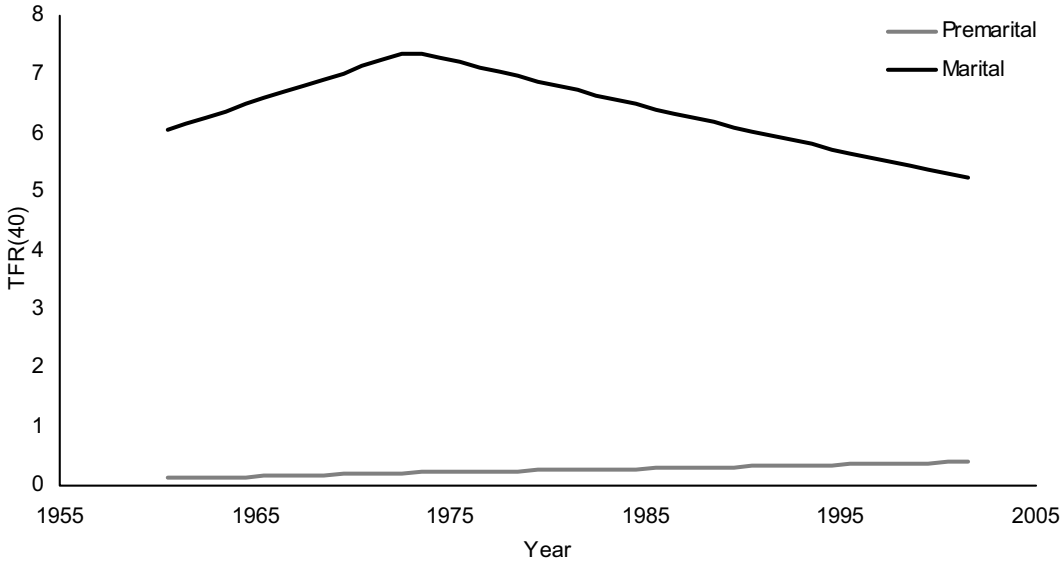


Figure B.30.2 Trends in Marital and Premarital Fertility, Zambia, 1960-2003



Zimbabwe

Zimbabwe conducted DHS surveys in 1988, 1994, and 1999, covering 1973-1999. The results from all three surveys showed similar fertility levels and trends and indicated a consistent decline over the period covered.

Data from censuses conducted in 1969 and in 1992 provide additional evidence on fertility trends (Table B.31). These data indicate a TFR(40) of approximately 5.2 (CFS = 5.7) prior to 1950 that subsequently increased steadily. The trend in Zimbabwe is similar to the trend in Zambia, although fertility levels were higher in Zimbabwe.

Table B.31 Estimated fertility levels, Zimbabwe, 1924-1991

Source (survey name, date)	Type of fertility data (age group)	Reference period	P(40)	P(50)
Census, 1969	CEB(70+)	1924.3	4.86	5.40
Census, 1969	CEB(60-69)	1934.3	5.21	5.79
Census, 1969	CEB(50-59)	1944.3	5.41	6.02
Census, 1969	CEB(40)	1959.3	5.78	6.24
Period fertility				
Census, 1992	TFR(40)	1991.5	4.15	4.71

As in Zambia, the period covered by the DHS survey data for Zimbabwe probably began after fertility peaked (Figure B.31.1). The results of the DHS surveys show divergent fertility trends in urban and rural areas. In urban areas, fertility declined rapidly and steadily between 1973 and 1999, with a highly significant slope ($p < 0.00001$). In rural areas, fertility levels reached a plateau between 1977 and 1982 ($p = 0.800$) before declining rapidly ($p < 0.00001$). The slope for rural areas after 1982 was significantly steeper than for urban areas ($p < 0.00001$), which is rare in sub-Saharan Africa.

The proportion of premarital births remained at approximately 6 percent in Zimbabwe and tended to increase over time, but premarital fertility levels remained very low compared with marital fertility levels (Figure B.31.2).

Figure B.31.1 Trends in Cumulated Fertility by Age 40, Zimbabwe, 1950-1999

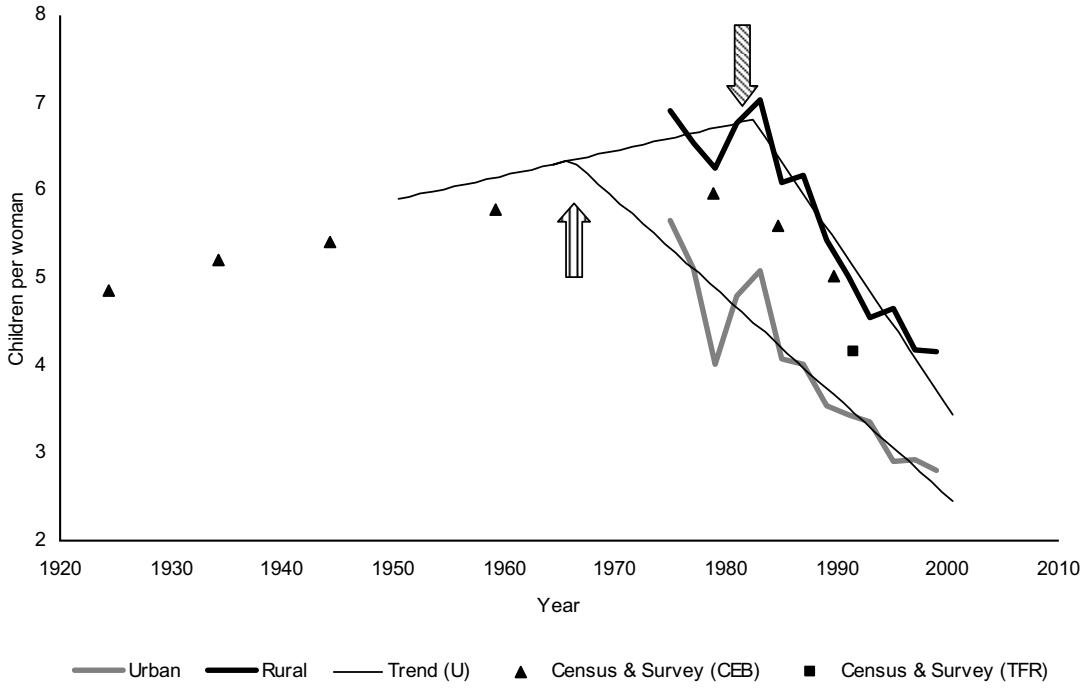
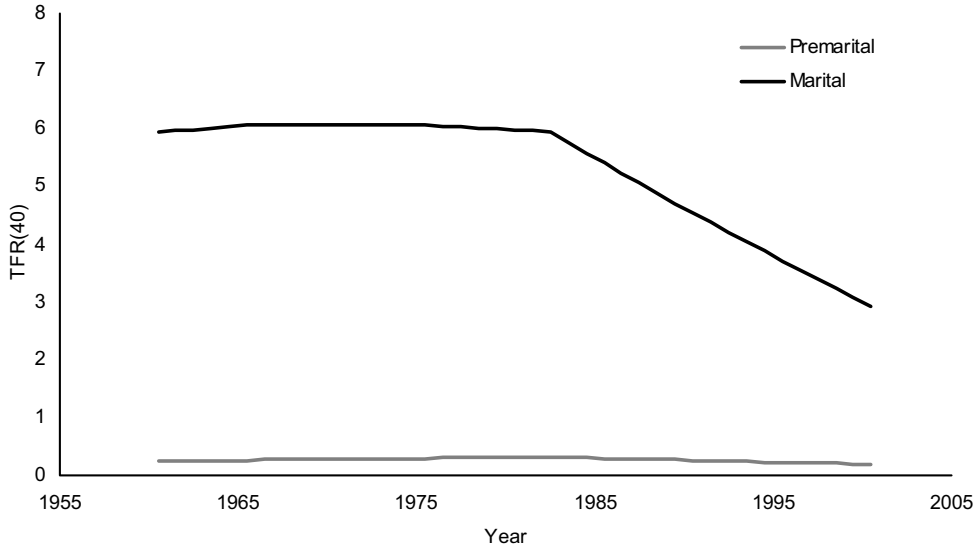


Figure B.31.2 Trends in Marital and Premarital Fertility, Zimbabwe, 1960-1999



Appendix C

Table C.1 Periods of monotonic change in fertility, urban areas, sub-Saharan Africa

	Monotonic period			Trend line		
Country	Onset	End	Number of births	Intercept	Slope	Standard deviation
Benin	1967	1983	607	-10.78541	0.00835	0.02388
Benin	1983	2001	1674	266.64689	-0.13131	0.01360
Botswana	1973	1988	533	213.70975	-0.10567	0.02419
Burkina Faso	1978	2003	1732	314.90717	-0.15568	0.00980
Burundi	1972	1981	34	214.52015	-0.10571	0.17040
Burundi	1981	1987	32	95.86692	-0.04581	0.26246
Cameroon	1963	1983	926	-119.09992	0.06306	0.01568
Cameroon	1983	2004	3237	216.47415	-0.10626	0.00777
Central African Republic	1980	1987	412	-85.68666	0.04602	0.05980
Central African Republic	1987	1995	582	401.15064	-0.19897	0.04868
Chad	1982	2004	1158	119.69011	-0.05688	0.01491
Comoro Islands	1981	1996	306	283.57871	-0.14034	0.03252
Congo	1990	2005	1576	89.22526	-0.04283	0.01225
Côte d'Ivoire	1966	1982	1018	50.61129	-0.02245	0.01970
Côte d'Ivoire	1982	1999	1537	400.44266	-0.19883	0.01603
Ethiopia	1985	2005	1782	337.93880	-0.16762	0.00960
Gabon	1986	2001	1806	362.83338	-0.17977	0.01394
Ghana	1965	1975	591	42.81579	-0.01896	0.03578
Ghana	1975	1998	2795	222.35820	-0.10981	0.00659
Ghana	1998	2003	507	-90.64050	0.04671	0.04287
Guinea	1984	2005	1722	233.59669	-0.11454	0.01226
Kenya	1963	1997	2533	249.73159	-0.12361	0.00579
Kenya	1997	2003	526	57.13855	-0.02693	0.04207
Lesotho	1962	1980	125	-129.57895	0.06821	0.05332
Lesotho	1980	2005	657	281.51027	-0.13972	0.01609
Liberia	1971	1986	862	69.69603	-0.03224	0.02248
Madagascar	1977	1987	546	220.56107	-0.10886	0.03876
Madagascar	1987	1993	793	-109.55505	0.05721	0.04638
Madagascar	1993	2004	922	193.31990	-0.09480	0.02412
Malawi	1977	2005	1779	250.34720	-0.12308	0.01026
Mali	1972	1990	1364	-0.85890	0.00371	0.01763
Mali	1990	2001	1706	249.67967	-0.12242	0.02133
Mozambique	1982	2004	2496	174.90249	-0.08531	0.00977
Namibia	1977	2000	2053	130.54348	-0.06383	0.00770
Niger	1977	1998	1017	271.77427	-0.13344	0.01696
Nigeria	1967	1983	1244	-92.03305	0.04947	0.01869
Nigeria	1983	1997	1924	171.63117	-0.08371	0.01478
Nigeria	1997	2003	679	-214.35561	0.10942	0.05083
Rwanda	1968	2005	1435	135.26281	-0.06534	0.00947
Senegal	1963	1976	633	64.05351	-0.02930	0.02893
Senegal	1976	2005	5430	228.99143	-0.11261	0.00451
Tanzania	1977	1995	2166	227.43552	-0.11208	0.01145
Tanzania	1995	2005	1159	77.22335	-0.03686	0.02069
Togo	1973	1980	169	-177.78447	0.09261	0.09139
Togo	1980	1998	1463	306.35495	-0.15196	0.01240
Uganda	1974	2001	1036	215.49946	-0.10575	0.01342
Zambia	1977	2002	3646	236.85939	-0.11631	0.00770
Zimbabwe	1974	1999	2193	229.37296	-0.11346	0.00764

Table C.2 Periods of monotonic change in period fertility, rural areas, sub-Saharan Africa

Country	Monotonic period		Number of births	Trend line		
	Begin	End		Intercept	Slope	Standard deviation
Benin	1967	1990	2306	-104.70736	0.05628	0.00861
Benin	1990	2001	1881	271.19313	-0.13268	0.02003
Botswana	1973	1988	1209	197.14344	-0.09677	0.01781
Burkina Faso	1978	1986	1333	-126.36598	0.06756	0.03035
Burkina Faso	1986	2003	6863	161.04461	-0.07736	0.00717
Burundi	1972	1987	1455	7.72769	-0.00075	0.01711
Cameroon	1963	1983	3074	-136.52353	0.07215	0.00934
Cameroon	1983	2004	3796	62.15259	-0.02806	0.00806
Central African Republic	1980	1989	824	-244.23871	0.12589	0.03397
Central African Republic	1989	1995	639	451.95261	-0.22432	0.06205
Chad	1982	1997	3191	-40.18228	0.02364	0.01193
Chad	1997	2004	1162	552.48646	-0.27275	0.03564
Comoro Islands	1981	1987	287	-253.89701	0.13107	0.08241
Comoro Islands	1987	1996	508	417.43386	-0.20683	0.04529
Congo	1990	2005	1221	-21.48545	0.01346	0.01758
Côte d'Ivoire	1966	1987	2400	-33.35731	0.02035	0.00940
Côte d'Ivoire	1987	1999	1659	414.24432	-0.20485	0.02320
Ethiopia	1985	2005	9014	199.20539	-0.09660	0.00586
Gabon	1986	2001	484	78.40048	-0.03644	0.03012
Ghana	1965	1985	2997	16.36082	-0.00516	0.00911
Ghana	1985	1998	3046	207.07985	-0.10122	0.01259
Ghana	1998	2003	605	-204.83691	0.10493	0.06199
Guinea	1984	1995	2263	-162.88153	0.08510	0.01847
Guinea	1995	2005	2283	190.49414	-0.09207	0.02051
Kenya	1963	1980	3891	50.12864	-0.02146	0.00892
Kenya	1980	1997	7377	360.67798	-0.17827	0.00680
Kenya	1997	2003	1425	-95.71686	0.05042	0.03584
Lesotho	1962	1980	1467	-165.69941	0.08690	0.01605
Lesotho	1980	2005	1892	182.17202	-0.08912	0.01277
Liberia	1971	1986	1214	-182.48907	0.09525	0.01880
Madagascar	1977	2004	6443	117.27999	-0.05584	0.00543
Malawi	1977	2005	9646	108.03345	-0.05108	0.00465
Mali	1972	1990	3715	-127.81746	0.06824	0.01026
Mali	1990	2001	4232	306.89394	-0.15016	0.01373
Mozambique	1982	1992	2469	-110.47129	0.05848	0.01798
Mozambique	1992	2004	3885	19.65290	-0.00695	0.01346
Namibia	1977	2000	2600	151.04035	-0.07337	0.00861
Niger	1977	1998	4561	111.09838	-0.05209	0.00796
Nigeria	1967	1983	4430	-39.61185	0.02319	0.00981
Nigeria	1983	1997	4560	131.11275	-0.06284	0.01003
Nigeria	1997	2003	1371	-321.95594	0.16384	0.03990
Rwanda	1968	1982	2433	-41.11344	0.02438	0.01395
Rwanda	1982	1999	6900	233.24329	-0.11404	0.00683
Rwanda	1999	2005	2034	68.28538	-0.03133	0.03176
Senegal	1963	1982	2240	-72.29744	0.04017	0.01118
Senegal	1982	2005	6121	135.30356	-0.06460	0.00557
Tanzania	1977	1995	6525	88.96062	-0.04165	0.00727
Tanzania	1995	2005	2863	1.92485	0.00199	0.01750
Togo	1973	1980	376	-49.92329	0.02885	0.06322
Togo	1980	1998	2724	169.76016	-0.08210	0.01111
Uganda	1974	2001	6272	43.78137	-0.01851	0.00564
Zambia	1977	2002	4532	108.21828	-0.05110	0.00717
Zimbabwe	1974	1982	838	-13.40051	0.01020	0.04026
Zimbabwe	1982	1999	3234	375.76176	-0.18616	0.01005

Table C.3 Dates of onset and speed of the fertility decline in selected sub-Saharan African countries

Country	Year of latest survey	Onset of the fertility decline		Split between urban and rural fertility trends	Speed of transition	
		Urban	Rural		Urban	Rural
Benin	2001	1986	1990	1961	-1.27	-1.27
Botswana	1988	1968	1976	1969	-1.04	-0.97
Burkina Faso	2003	1976	1983	1977	-1.50	-0.77
Burundi	1987	1970	NA	1971	-1.05	NA
Cameroon	2004	1982	1984	1964	-1.06	-0.28
Central African Republic	1994	1987	1989	1987	-1.99	-2.87
Chad	2004	1986	2000	1986	-0.60	-2.98
Comoro Islands	1996	1980	1988	1981	-1.41	-2.07
Congo	2005	1967	>2005	1968	-0.44	NA
Côte d'Ivoire	1999	1968	1989	1967	-1.08	-1.94
Ethiopia	2005	1979	1991	1980	-1.69	-0.97
Gabon	2000	1984	1984	1984	-1.80	-0.36
Ghana	2003	1950	1986	1950	-0.56	-0.55
Guinea	2005	1986	1995	1987	-1.15	-0.92
Kenya	2003	1960	1970	1960	-0.95	-0.77
Lesotho	2004	1977	1977	1960	-1.40	-0.87
Liberia	1986	1974	NA	1974	-0.32	NA
Madagascar	2003	1971	1980	1971	-0.80	-0.56
Malawi	2004	1977	1978	1978	-1.22	-0.51
Mali	2001	1986	1991	1968	-1.22	-1.43
Mozambique	2003	1984	>2003	1985	-0.83	NA
Namibia	2000	1958	1975	1958	-0.64	-0.71
Niger	1997	1975	1976	1976	-1.33	-0.52
Nigeria	2003	1980	1986	1960	-0.47	-0.12
Rwanda	2005	1966	1983	1967	-0.65	-0.77
Senegal	2005	1963	1983	1963	-0.79	-0.62
Tanzania	2004	1973	1979	1974	-0.95	-0.24
Togo	1998	1967	1981	1967	-1.24	-0.82
Uganda	2001	1968	1970	1970	-1.05	-0.18
Zambia	2001	1973	1973	1973	-1.16	-0.51
Zimbabwe	2005	1965	1983	1965	-1.11	-1.87

NA = not available.

References

Basu, A.M. 2007. On the prospects for endless fertility decline in South Asia. In United Nations (Ed.), Completing the fertility transition. New York, New York, USA: United Nations, Population Division, pp. 554-561.

Blacker, J. 2007. Kenya's fertility transition: How low will it go? In United Nations (Ed.), Completing the fertility transition. New York, New York, USA: United Nations Population Division, pp. 457-468.

Bongaarts, J. 2005. The causes of stalling fertility. Population Council Working Paper No. 204.

Caldwell, J.C. 1994. Fertility in sub-Saharan Africa: status and prospects. Population and Development Review 20(1): 179-187.

Caldwell, J.C., and P. Caldwell. 1993. The South African fertility decline. Population and Development Review 19(2): 225-262.

Caldwell, J.C., I.O. Orubuloye, and P. Caldwell. 1992. Fertility decline in Africa: A new type of transition? Population and Development Review 18(2): 211-242.

Camlin, C., M. Garenne, and T. Moultrie. 2004. Fertility trends and patterns in a rural area of South Africa in the context of HIV/AIDS. African Journal of Reproductive Health 8(2): 38-54.

Castro-Martin, T. 1995. Women's education and fertility: Results from 26 Demographic and Health Surveys. Studies in Family Planning 26(4): 187-202.

Cleland, J., N. Onuoha, and I. Timaeus. 1994. Fertility change in sub-Saharan Africa: A review of evidence. In T. Locoh and V. Hertrich (Eds.), The onset of fertility transition in sub-Saharan Africa. Liège, Belgium: Derouaux Ordina.

Cohen, B. 1998. The emerging fertility transition in sub-Saharan Africa. World Development 26(8): 1431-1461.

Dyson, T. 1988. Decline of traditional fertility restraints: demographic effects in developing countries. IPPF Medical Bulletin 22(6): 1-3.

Dyson, T., and M. Murphy. 1985. The onset of fertility transition. Population and Development Review 11(3): 399-440.

Dyson, T., and M. Murphy. 1986. Rising fertility in developing countries. In R. Woods and P. Rees (Eds.), Population structures and models: Developments in spatial demography. Boston, Massachusetts, USA, and London, England: George Allen and Unwin, pp. 68-94.

Feysetan, B.J., and A. Bankole. 2002. Fertility transition in Nigeria: trends and prospect. In United Nations, Department of Economic and Social Affairs, Population Division (Ed.), Completing the fertility transition. New York, New York, USA: United Nations Available at http://www.un.org/esa/population/publications/completingfertility/RevisedBANKOLEpaper.PDF.

Frank, O. 1983. Infertility in sub-Saharan Africa: Estimates and implications. Population and Development Review 9(1): 137-144.

Gaisie, S.K. 1996. Demographic transition: The predicament of sub-Saharan Africa. Health Transition Review 6 (Suppl.): 345-369.

Garenne, M. 2004. Age at marriage and modernization in sub-Saharan Africa. Southern African Journal of Demography 9(2): 57-77.

Garenne, M., and V. Joseph. 2002. The timing of the fertility transition in sub-Saharan Africa. World Development, 30(10): 1835-1843.

Garenne, M., S. Tollman, K. Kahn, and M. Collison. 2007. Fertility trends and net reproduction in Agincourt: 1992-2004. Scandinavian Journal of Public Health 35; in press.

Garenne, M., and J. Zwang. 2006. Premarital fertility and ethnicity in Africa. DHS Comparative Reports No 13.

Gobopamang, L., and H.N. Letamo. 2001. The role of proximate determinants in fertility transition: A comparative study of Botswana, Zambia and Zimbabwe. Southern African Journal of Demography 8(1): 29-35.

Gould, W.T., and M.S. Brown. 1996. A fertility transition in Sub-Saharan Africa? International Journal of Population Geography 2(1): 1-22.
Harwood-Lejeune, A. 2000. Rising age at marriage and fertility in southern and eastern Africa. European Journal of Population 17: 261-280.
Kirk, D., and B. Pillet. 1998. Fertility levels, trends, and differentials in sub-Saharan Africa in the 1980s and 1990s. Studies in Family Planning 29(1): 1-22.
Larsen, U., and H. Raggers. 2001. Levels and trends in infertility in sub-Saharan Africa**.** In J. Ties Boerma and Z. Mgalla (Eds.), Women and infertility in sub-Saharan Africa: A multi-disciplinary perspective. Amsterdam, the Netherlands : Royal Tropical Institute, KIT Publishers, pp. 25-69.
Leridon, H., and L. Toulemon. 1996. La régulation des naissances se généralise. Les Dossiers du CEPED No. 41.
Lesthaeghe, R., and C. Jolly. 1995. The start of the sub-Saharan fertility transition: Some answers and many questions. Journal of International Development 7(1): 25-45.
Lindstrom, D.P., and Z. Woubalem. 2003. The demographic components of fertility decline in Addis Ababa, Ethiopia: A decomposition analysis. Genus 54 (3-4): 147-158.
Maddison, A. 2003. L'économie mondiale: statistiques historiques. Paris, France: Organisation for Economic Co-Operation and Development.
Mbacke, C. 1994. Family planning programs and fertility transition in sub-Saharan Africa. Population and Development Review 20(1): 188-193.
McFalls, J.A., and M.H. McFalls. 1984. Disease and fertility. New York, New York, USA: Academic Press.
McNicoll, G. 1992. Changing fertility patterns and policies in the third world. Annual Review of Sociology 18: 85-108.
Mostert, W.P., J.L. van Tonder, and B.E. Hofmeyr. 1988. Demographic trends in South Africa. In: H.C. Marais (Ed.), South Africa: Perspectives on the future. Pinetown, South Africa: Owen Burgess, pp. 59-86.
Moultrie, T., and I. Timaeus. 2003. The South African fertility decline: Evidence from two censuses and a Demographic and Health Survey. Population Studies 57(3): 265-284.
National Academy of Sciences. 1993. Demographic change in sub-Saharan Africa. Washington, D.C., USA: National Academies Press.
Ngom, P., and S. Fall. 2005. Fertility decline in francophone sub-Saharan Africa: 1980-2010. Nairobi, Kenya: African Population and Health Research Center, Inc. Working Paper 26.
Rutenberg, N. 1991. Knowledge of contraception. DHS Comparative Studies No. 5. Columbia, Maryland, USA: IRD-Macro International.
Rutenberg, N., and I. Diamond. 1993. Fertility in Botswana: The recent decline and future prospects. Demography 3(2): 143-157.
Ryder, N.B. 1983. Cohort and period measures of changing fertility. In: R.A. Bulatao and R.D. Lee (Eds.), Determinants of fertility in developing countries. Volume 2. Fertility regulation and institutional influences. New York, New York, USA: Academic Press, pp. 737-756.
Shapiro, D., and T. Gebreselassie. 2007. Fertility transition in sub-Saharan Africa: Falling and stalling. Paper presented at the 2007 Annual Meeting of the Population Association of America, New York, New York, USA.
Shemeikka, R., V. Notkola, and H. Siiskonen. 2005. Fertility decline in North-Central Namibia: An assessment of fertility in the period 1960-2000 based on parish registers. Demographic Research 13(4): 83-116.
Swartz, L. 2003. Fertility transition in South Africa and its implications on the four major population groups. In Human Sciences Research Council (Ed.), Fertility: Current South African issues of poverty, HIV/AIDS and youth. Cape Town, South Africa: Human Sciences Research Council, pp. 7-26.
United Nations. 1978. Demographic yearbook 1978. Special issue: Historical supplement. New York, New York, USA: United Nations, Statistical Office.

United Nations. 1997. Demographic yearbook 1997. Historical supplement. New York, New York, USA: United Nations, Statistics Division.
United Nations. 2000. Demographic yearbook 2000. New York, New York, USA: United Nations, Statistics Division.
United Nations. 2001. The state of demographic transition in Africa. Addis Ababa, Ethiopia: United Nations Economic Commission for Africa.
United Nations. 2007a. World population prospects: The 2006 revision. New York, New York, USA: United Nations, Population Division.
United Nations. 2007b. Completing the fertility transition. New York, New York, USA: United Nations, Population Division.
van de Walle, E., and J. Knodel. 1980. Europe's fertility transition: New evidence and lessons for today's developing world. Population Bulletin 34(6): 3-44.
van de Walle, E., and A.D. Foster. 1990. Fertility decline in Africa: Assessment and prospects. World Bank Technical Paper No. 125 (Africa Technical Department Series). Washington, D.C., USA: World Bank.

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