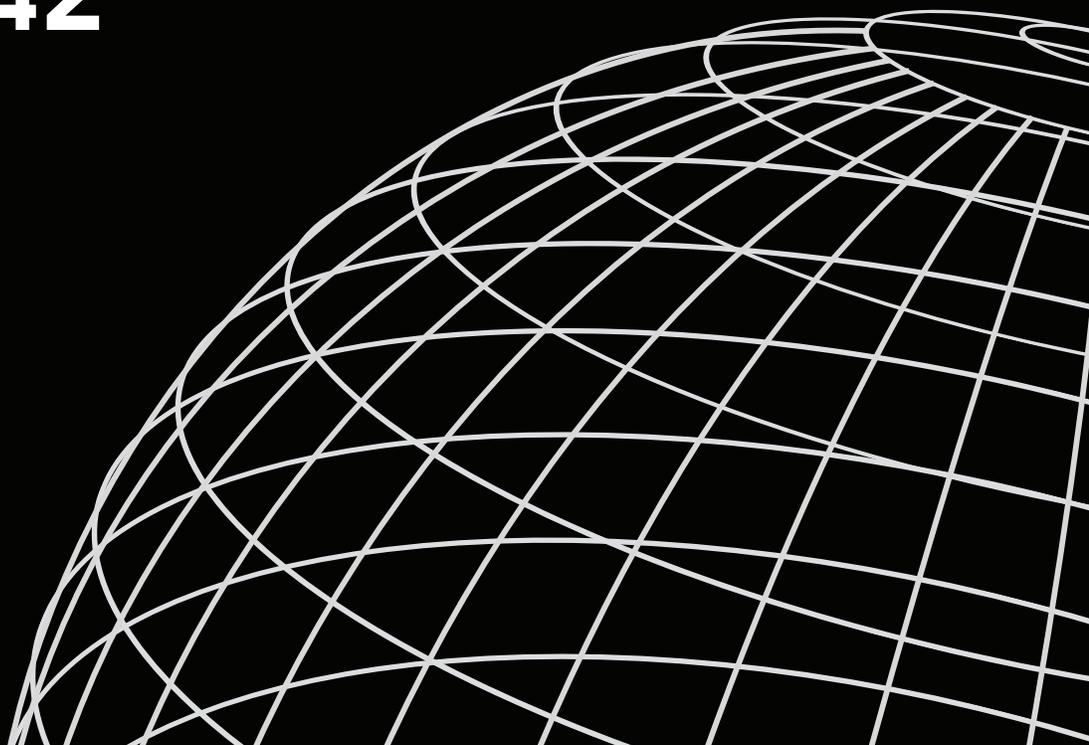




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TRENDS IN MARRIAGE AND CONTRACEPTION IN SUB-SAHARAN AFRICA: A LONGITUDINAL PERSPECTIVE ON FACTORS OF FERTILITY DECLINE

DHS ANALYTICAL STUDIES 42



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**Trends in Marriage and Contraception in Sub-Saharan Africa:
A Longitudinal Perspective on Factors of Fertility Decline**

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Preface

One of the most significant contributions of The 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 analysis of 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.

While *Comparative Reports* are primarily descriptive, *Analytical Studies* provide in-depth, focused studies on a variety of substantive topics. The studies are based on a varying number of data sets, depending on the topic being examined. These studies employ a range of methodologies, including multivariate statistical techniques.

The DHS Program staff, in conjunction with the U.S. Agency for International Development (USAID), selects the topics covered in *Analytical Studies*.

It is anticipated that the *DHS Analytical Studies* will enhance the understanding of analysts and policymakers regarding significant issues in the fields of international population and health.

Sunita Kishor
Director, The DHS Program

Executive Summary

This study presents an analysis of the relationships among age at marriage, contraceptive use, and fertility in 33 sub-Saharan African countries. The Demographic and Health Surveys (DHS) Program provided all of the data on marriage, contraception, and fertility. Median age at marriage was defined as the age at which half of a cohort is ever-married. Contraceptive use was defined as ever-use of modern contraception by age 40. Fertility was defined as cumulated fertility by age 40. All calculations were done for urban and rural areas separately, for cohorts and periods. The study makes extensive use of conversion of cohort estimates into period estimates for reconstructing characteristics of synthetic cohorts. Period estimates of age at marriage were calculated from cohort estimates and age patterns of fertility. Cohort estimates of contraceptive use were calculated from period estimates and an estimated age pattern.

Median age at marriage of synthetic cohorts increased by some 3.3 years between 1950 and 2005 in urban areas, and some 1.1 years in rural areas. Age at marriage increased in all urban areas, but in only half of the rural areas in countries studied. Trends in age at marriage were not always steady, and reversed in seven countries. Some of these reversals were associated with economic crises, others with political crises or civil wars. Trends in age at marriage had little correlation with trends in level of education, or with trends in income per capita. Fertility trends also had virtually no correlation with trends in age at marriage in countries studied. Trends in age at marriage could explain only a tiny fraction of fertility trends.

Contraceptive use increased in all countries studied, earlier and more so in urban areas than in rural areas. Ever-use of contraception also occurred at an earlier age in urban areas than in rural areas. Trends in contraceptive use were highly correlated with fertility trends. Overall, in urban areas fertility was reduced by 49% by year 2005, while ever-use of contraception reached 49% of the population. In rural areas, fertility was reduced by 14% by year 2005, while ever-use of contraception reached 28% of the population. Contraceptive use could potentially explain all the fertility decline. However, it was compounded by a relatively low level of current-use, on average 43% of ever-use.

In a multivariate analysis, trends in ever-use of contraception explained about half of fertility trends. The percentage was increased to about 64% when the extent of contraception was added, measured by the ratio of current-use to ever-use, and was reduced to about 22% in settings with low current-use of contraception. In contrast, whatever the model, the role of age at marriage appeared small, explaining less than 10% of fertility decline. The impact was further reduced by the emergence of premarital fertility, especially in urban areas.

The longitudinal analysis of the relationships among trends in marriage, contraception, and fertility leads to different conclusions than cross-sectional analysis. While in cross-sectional analysis age at marriage had a significant effect on fertility at the individual level; in longitudinal analysis trends in age at marriage had virtually no effect on fertility trends.

1. Introduction

1.1 Fertility Changes

The 20th century witnessed a major decline in fertility worldwide, although fertility had started to decline earlier in Europe, but had not yet started to decline in some remote rural areas of sub-Saharan Africa. According to the United Nations Population Division, for the world as a whole, the total fertility rate (TFR) declined from 4.97 children per woman in 1950-1954 to 2.53 in 2005-2010. For developing countries together, the changes were even more dramatic over this period, from a TFR of 6.08 to 2.69, while in sub-Saharan Africa the changes were much smaller, from a TFR of 6.53 to 5.39 (UNPD, 2012).

Fertility changes in developing countries are attributed to extensive use of modern contraception, which occurred in the context of economic development and social change, in particular rising levels of modern education. In this respect, sub-Saharan Africa appears as the region of the world where levels of contraceptive use, economic development, and education are the lowest, which could explain the slower or later fertility decline and the higher fertility level in 2010 (Bongaarts and Casterline, 2012; Caldwell et al., 1992; Caldwell, 1994; Casterline, 1999; Cleland et al., 1994; Garenne and Joseph, 2002; Garenne, 2008; Gould and Brown, 1996; Kirk and Pillet, 1998; Lestaeghe and Jolly, 1995; Machiyama, 2010; Ngom and Fall, 2005; Sneeringer, 2009).

1.2 Economic Development and Social Change

The relationship of fertility decline with economic development is complex, but overall in developing countries and over a long period of time (1950-2008) both occurred simultaneously. Worldwide, fertility decline occurred while income per capita rose by a factor of 3.6 between 1950 and 2008. In Asia the impressive fertility decline occurred while income per capita rose by a factor of 7.8, while in Africa the smaller fertility decline occurred while income per capita doubled (Maddison, 2010). In some countries however, fertility declined while income per capita stagnated, or even fell, as in several African countries such as Côte d'Ivoire, Gabon, Liberia, Madagascar, Sierra Leone, and Zimbabwe.

In developing countries, fertility decline usually has occurred earlier and faster in urban areas than in rural areas, for a variety of reasons, and in particular because of wider availability of modern contraception. Urban areas are also associated with higher levels of income, higher levels of education, and better access to mass media (Rustein, 2002; Westoff et al., 2011).

In cross-sectional studies, the level of education is universally found to be negatively associated with fertility (women with more education have lower fertility), and this is true also in international comparisons: countries with higher levels of education tend to have lower fertility (Castro-Martin, 1995; Chimere-Dan, 1993; Cleland and Rodriguez, 1988; Bongaarts, 2010; Kravdal, 2002; Lloyd et al., 2000; United Nations, 1995 and 2007). However, the relationship between trends in level of education and trends in fertility appears complex (Shapiro, 2011; Garenne, 2012). Studies also found exposure to mass media to be closely associated with desire for fewer children and with higher levels of contraceptive use (Westoff et al., 2011).

1.3 Changes in Marriage Patterns

Marriage is often considered an important fertility determinant associated with economic development and social change. With economic development, age at marriage tends to rise, although the relationships between both are complex and remain poorly investigated (Bledsoe and Pison, 1994; van de Walle, 1968 and 1993; Doddo, 1998). Economic development could occur for long periods of time without much

change in age at marriage, and age at marriage could change rapidly even without economic development. In cross-sectional studies, early marriage is associated with high fertility, and later age marriage is associated with lower fertility (Althaus, 1991; Burch, 1983; Quisumbing and Hallman, 2003; Smith, 1983; Udjo, 2001; Westoff et al., 1994). However, little research has been conducted on the relationship between marriage trends and fertility trends in a longitudinal perspective (Hardwood-Lejeune, 2000). In Africa the matter is further complicated by the emergence of premarital fertility, and by new forms of living arrangements, such as informal cohabitation (Garenne et al., 2000; Garenne and Zwang, 2004, 2005 and 2006; Wawire and Jensen, 2013).

1.4 Family Planning Programs and Contraceptive Use

Most fertility declines in developing countries appear to be closely associated with the growing use of modern contraception, and with family planning programs. In fact, there is no documented case of sustained fertility decline without extensive use of modern contraception, and this rarely occurs without large-scale family planning programs.

In sub-Saharan Africa family planning clinics (public and private) and family planning programs started in the 1960s in selected countries, extended their reach in the 1970s, and became widespread in the 1980s, reaching all major urban areas, and also many rural areas. Even by year 2005, however, some rural areas remained poorly served. The dynamics of family planning programs and services seem quite independent of economic development and social change in Africa, and have been determined primarily by national health policies and by international aid and cooperation (Bongaarts, 2011; Cleland et al., 2010; David, 1992; Mbacke, 1994; Ross et al., 2005).

1.5 Context of the Study

This study was undertaken in the context of economic development, social change, and family planning programs in sub-Saharan Africa. Its aim is to better understand the long-term fertility trends that have occurred since 1960 and their relationships with changing marriage patterns and the emergence of modern contraceptive use.

2. Framework for Analysis

This section presents the approach followed for the study of the relationships among marriage, contraception, and fertility trends in sub-Saharan Africa.

2.1 Theoretical Framework of Proximate Determinants

The classic theoretical framework for studying fertility levels and trends is that of proximate determinants, presented by Kingsley Davis and Judith Blake over half a century ago (Davis and Blake, 1956). The framework was further refined and expanded, although it remained similar in principle to the original version (Bongaarts, 1978; Bongaarts et al., 1984; Bongaarts and Jones, 1982; Bryant, 2007). The proximate determinants framework presents all the known mechanisms of exposure to conception and fertility regulation.

The proximate determinant framework used for this study was adapted to the availability of data in DHS surveys and to the nature of the fertility transition in Africa, and is summarized in Table 1. Several points deserve special attention. The information on induced abortion, probably an important regulator of fertility in urban Africa, is not documented in DHS surveys and not available elsewhere. The cohort information on contraception is concentrated on ever-use of modern contraception. Current-use is also available at the dates of the surveys, but not in a long term longitudinal perspective. The issue of premarital fertility, that is, fertility before the first marriage, is important in Africa, and has been investigated in another report (Garenne and Zwang, 2006). In Africa, premarital fertility may compensate for the effect of increasing age at marriage, if women continue to have children early while marrying later, as in Southern Africa. This study will focus on the net effect of age at marriage, which may be negligible if premarital fertility remains high when age at marriage increases.

Table 1. Basic framework of proximate determinants of fertility decline in Africa

| | Proximate determinant | Confounder |
|--|---|---|
| Selected | Contraceptive use (ever-use modern methods) Age at first marriage | Periods of use (current use /ever use) Premarital fertility |
| Missing | Induced abortion | |
| Others, changes assumed to be negligible | Marital disruption, divorce, widowhood, spouse separation, coital frequency | HIV/AIDS |
| | Primary and secondary infertility, puberty, menopause, breastfeeding, intra-uterine mortality, infertility due to emerging diseases | HIV/AIDS |

The present study focuses on marriage and contraception, two of the leading proximate determinants, and simply ignores the other factors of natural fertility, because they are not documented (induced abortion), or because they are assumed to be constant or negligible. This was obviously not the case in sub-Saharan Africa over the years, and in particular it seems that fertility increased significantly in many countries in the 1950s and 1960s, probably because of a reduction in primary and secondary infertility (Garenne, 2008). This is why some of the figures presented in this report show an increase in fertility in the early

years, despite slowly emerging contraceptive use. This later point is beyond the scope of this study and would require another analysis.

Likewise, the net effect of HIV/AIDS on fertility is assumed to be small in comparison with that of marriage and contraception. For instance, in a population with 10% prevalence of HIV, fertility will plausibly be reduced by 5% because of the effect of HIV on fecundability, and probably by some additional small amount because of the effect on marital disruption. The effects of HIV/AIDS on fertility are also beyond the scope of this study.

Nevertheless, as will be seen below, all cases of fertility decline in this study appeared primarily associated with increased contraceptive use, and there is no documented evidence that they were associated with major changes in any other known factors of natural fertility, although this last point remains poorly investigated with respect to induced abortion. Furthermore, fertility decline could also be associated with increasing age at marriage and declining proportions marrying. In fact, first marriage is usually the starting point for exposure to fertility, so that age at marriage and proportions marrying were considered as key determinants of fertility levels, at least until recently, when marriage and first birth have become increasingly independent of each other, and when premarital fertility emerged as a serious confounder.

2.2 Fertility Trends in Africa

Fertility trends in Africa have been the focus of synthetic work by the United Nations Population Division, as well as by several authors (United Nations, 2007; Bongaarts and Casterline, 2012; Casterline, 1999; Garenne, 2008; Machiyama, 2010; Sneeringer, 2009). Without entering into details covered elsewhere, three features of fertility trends need to be mentioned here. First, fertility appeared to be increasing in the middle of the 20th century, largely because of a reduction in primary and secondary sterility, and in a number of cases because of lower age at marriage. Second, fertility started to decline in the 1960s, 1970s or 1980s depending on the country, and this decline was moderate, and differed between urban and rural areas in timing and speed. Third, fertility stalls occurred in a number of countries for a variety of reasons, and at various stages of the fertility transition (Bongaarts, 2006; Garenne 2009, and 2011; Machiyama, 2010; Shapiro and Gebreselassie, 2008; Schoumaker, 2009).

2.3 Marriage and Fertility

The dynamic relationship between marriage and fertility is complex and has become even more complex in the recent years because marriage patterns have been changing. The fertility transition in Europe (roughly 1870-1930) occurred despite any large-scale change in age at marriage or proportions ever marrying; in fact, in the 1950s, women's age at marriage was lower than before and proportions marrying were larger. In ancient Europe, as well as in 20th century United States, marriage rates could change rapidly for short periods of time following a crisis (famine, war, economic recession, etc.), but these changes were quickly followed by a recovery and did not affect long-term trends (Kirk, 1960). In Europe, the fertility transition occurred in a context of very low premarital fertility (births before first marriage), usually only a small percentage of all births.

The situation is different in sub-Saharan Africa. First, age at marriage was very low in the 1950s, so low that it could hardly decline but could only increase (Garenne, 2004; van de Walle, 1968 and 1993). Second, age at marriage appeared susceptible to rapid changes, for a variety of reasons, as will be seen below. Third, premarital fertility exists in Africa, and could include more than half of women, as in Southern African countries (Garenne and Zwang, 2004 and 2005). When premarital fertility is widespread, the relationship between marriage and fertility becomes weaker, as births occur before or after first marriage, within or outside wedlock.

2.4 Contraception and Fertility

In contrast, the relationship between contraceptive use and fertility is simple and direct, and this applies to any period, before or after marriage, as soon as first sexual intercourse has occurred. If contraception is effective, periods of sexual activity from first intercourse to menopause protected by contraception have nil fertility (in the absence of contraceptive failure), while unprotected periods of sexual activity have a natural fertility. So the person-years spent under effective contraception allow one to predict the level of fertility, given the underlying level of natural fertility. Unfortunately, the precise periods of contraceptive protection are not known for African countries, since available surveys provide only ever-use and current-use, without the date of onset of contraceptive use.

Since the approach of this study is long-term and longitudinal, the focus is on ever-use of contraception. In fact, women born early in the 20th century, say before 1920, were unlikely to have ever used modern contraception, since they were already age 40 or older when family planning programs and modern contraception emerged in Africa. So, ever-use of modern contraception is considered here as a critical factor for fertility control. Women who did not have access to family planning because they were born too early were under a natural fertility regime, while women age 15 in 2005 (born in 1990) were likely to have access to family planning services from an early age, and thus were likely to be able to use contraceptive methods unless they did not to do so for personal reasons.

The relationship between contraceptive use and fertility depends upon the modalities of contraceptive use. Women may use contraception to avoid a premarital or an extramarital birth, to space two marital births, or to limit their family size. They may start early, as soon as first intercourse, or much later when they have reached their fertility goal. The impact of contraceptive use on fertility is likely to be different in each case, and is expected to be larger in the case of limiting family size when desired family size is low. In a perfect contraceptive society with a target of 2 children per woman, one expects ever-use by age 40 to be close to 100% and the ratio of current-use to ever-use to be close to 80% (assuming 25 years of reproductive life span from first birth to last birth, and 5 years taken by two births intervals of 30 months).

2.5 Period and Cohort Effects

Period and cohort effects interact in the relationship between marriage, contraceptive use, and fertility. This longitudinal study differs from cross-sectional studies because of its emphasis on long-term trends. The main issue here is that age at marriage is primarily a cohort phenomenon, as well as ever-use of contraception, whereas fertility trends are a period phenomenon, measured as the fertility of a synthetic cohort. So, it was necessary for the study to devise a way of relating period and cohort effects. This was done by computing period estimates of age at marriage and of ever-use of contraception from cohort data, reconstructing the characteristics of the synthetic cohort used for fertility trends. The details of the computations are displayed in the methods section of Chapter 3.

2.6 Longitudinal versus Cross-Sectional Approach

The approach of this study is longitudinal, so that fertility trends are related with trends in marriage and trends in contraceptive use at the aggregate population level. This approach differs markedly from cross-sectional approach, which focuses on differentials between individuals or between social groups at a given point in time. For instance, age at marriage could be a strong factor in fertility differences among individuals, and yet have no effect on fertility trends if it does not change over time while contraceptive use increases, as was the case in ancient Europe. Another discrepancy could occur if age at marriage changes but premarital fertility occurs, so that changes in age at marriage do not translate into changes in fertility.

Similarly, universal contraceptive use after reaching desired family size could lead to a very low TFR (reflecting the full impact of cohort contraceptive prevalence on fertility control). But the years of exposure to fertility between first marriage and reaching desired family size would not be protected by contraceptive use, leading to only partial protection in terms of period contraceptive prevalence. Here again, cross-sectional estimates might lead to misleading results, unless precise periods of exposure to fertility are specified.

2.7 Socioeconomic Correlates of Marriage and Contraception

Beyond the strict demographic analysis of period and cohort trends, the study also attempts to relate these trends with trends in socioeconomic correlates. An earlier study investigated the relationship between level of education and fertility in a longitudinal perspective (Garenne, 2012). The current study investigates the relationship between women's age at marriage and women's level of education the same way, in a longitudinal perspective. The situation is the same as that of marriage and fertility. One could find large differentials in cross-sectional studies (women with more education having a higher age at marriage) while trends in education play no role in trends in age at marriage (either because education levels remain unchanged, or because marriage trends are determined by other causes). Furthermore, in a number of instances, marriage trends were related with trends in income per capita, and with economic or political crises.

2.8 Objectives of the Study

This study analyzes the relationships between trends in fertility, trends in marriage, and trends in contraceptive use in a long-term longitudinal perspective. The study covers, as much as possible, the 1950-2005 period and the corresponding cohorts of women age 15-49 (1901-1990 cohorts). The analysis is conducted for urban and rural areas separately, because urban and rural dynamics differ for fertility, for marriage, and for contraception. The study relates some of the changes with changes in level of education and with economic development.

2.9 Open Questions

The study addresses several questions of general interest for the demography of sub-Saharan Africa:

- What was the magnitude of the changes in age at marriage since 1950 in sub-Saharan Africa?
- Were the changes in age at marriage steady or erratic?
- Did the changes in age at marriage have an impact of fertility trends?
- Were the long-term changes in age at marriage attributable to changes in level of education?
- What were the other causes of short term changes in age at marriage?
- What was the extent of modern contraception by year 2005?
- Could this level of contraceptive use explain the fertility decline in urban and rural areas? If not, why not?
- What is the role of marriage and contraception on fertility trends in a multivariate analysis?

Of course, the answers to these questions are limited by the available quantitative data, and by their accuracy. In particular, DHS surveys do not cover all targeted periods and cohorts, and do not include the age at first use of modern contraception.

3. Data and Methods

This section describes the datasets used for the empirical study, the variables, and the methods followed for the longitudinal analysis.

3.1 Survey Data

Data were drawn from DHS and related surveys conducted in 33 countries of continental sub-Saharan Africa. In addition to DHS surveys, data from the earlier World Fertility Survey (WFS) were included because they were based on the same data-collection methods and provided a longer longitudinal perspective, covering earlier cohorts. The list of countries and surveys is displayed in Appendix (Table A-1). The countries studied covered about 88% of the total population of sub-Saharan Africa. The two African islands included in the DHS program (Comoros, Sao Tome and Principe) were excluded, as was Northern Sudan.

A total of 102 surveys were used for analysis of fertility trends and marriage trends. The analysis of trends in contraceptive use excluded the most recent surveys (DHS VI round) because they did not include the information on ever-use of contraception.

3.2 Available Variables

The longitudinal analysis is based on a few variables available in DHS surveys: date of birth (cohort), age at first marriage, ever-use and current-use of contraception, urban residence, and level of education, all taken from the women's files (Individual Recode file or 'IR' file).

Date of birth

The date of birth is provided by the 'V011' variable ('V008' in WFS surveys). These dates are recorded in month and year, following the CMC (century-month calendar) method of DHS surveys.

Date of first marriage

The date of first marriage is provided by the 'V509' variable in CMC, ('M012' in WFS surveys), which allows the computation of the age at first marriage in months.

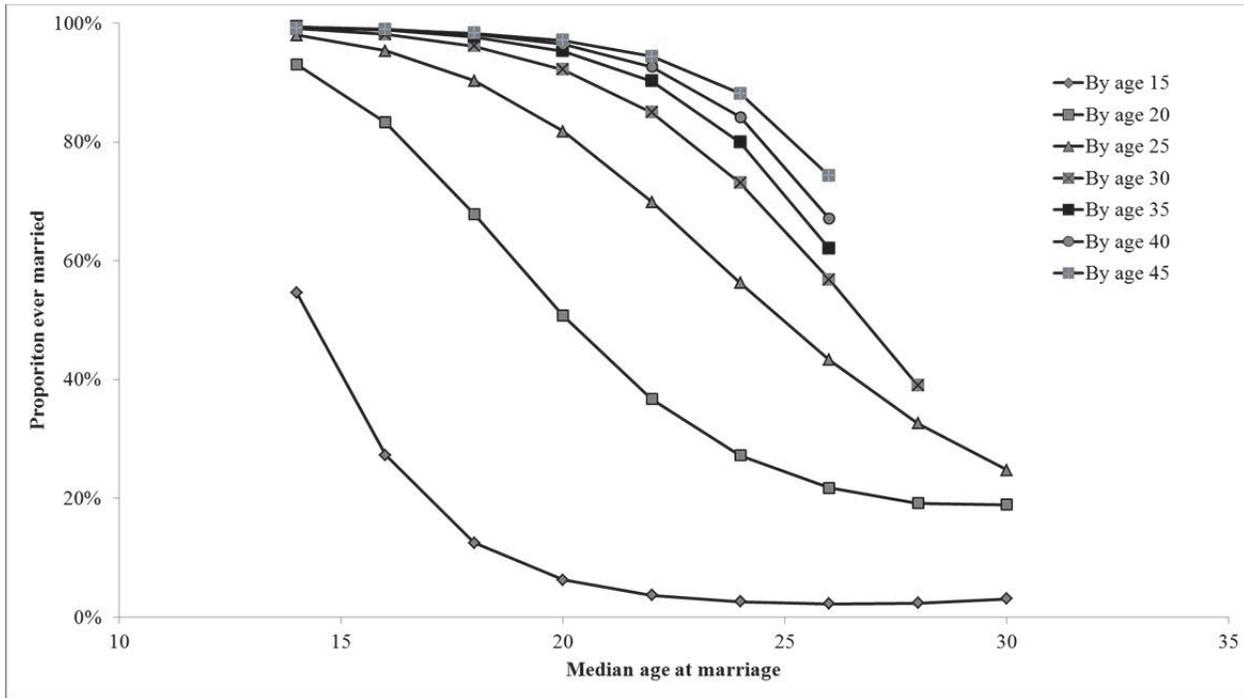
Cohort median at marriage

The cohort median age at marriage (labeled here simply median age at marriage) is defined as the age at which 50% of a cohort was ever-married. This definition differs somewhat from the classic median age at marriage, because it includes women who will never marry. The main advantage to using this definition is to allow computing the indicator for the younger generations, since the information on the proportion of women who never marry is not necessary. Another feature of this indicator is that it is more sensitive to rapid changes, because it includes at the same time the mean age at marriage for those who will ever marry and the proportion of terminal celibacy. When the proportion of women who never marry increases, the cohort median age at marriage increases too because it takes longer for 50% of the cohort to be ever-married. The cohort median age at marriage was calculated in months, and was transformed later into decimal values of years by dividing by 12 (a median age of 222 months is reported here as 18.5 years).

A single indicator of age at marriage was preferred over more complex indicators, such as the age-specific proportions ever-married. Indeed, there are monotonic relationships between these proportions

and the median age at marriage as computed in this study. These relationships were verified by computing the empirical quadratic relationship between selected values of the proportions ever-married at age 15, 20, 25, 30, 35 and the median age at marriage in all DHS surveys used in this study. Results of these empirical relationships appear in Figure 1. They clearly show a close correspondence.

Figure 1. Empirical relationships between proportions ever-married and cohort median age at first marriage in African DHS surveys



Premarital fertility

The effect of age at marriage on fertility may be reduced by premarital fertility, because women may marry later but have more premarital births. A simple indicator of premarital fertility was used: the proportion of premarital births at last survey (the endpoint).

Cohort ever-use of modern contraception

Cohort contraceptive use at age (x) is measured by the proportion of women who ever used modern contraception by age (x). The corresponding variable in DHS surveys is 'V302' (and 'V633' in WFS surveys). The coding of this variable changed between the DHS-I round (V302= 2) and DHS-II to DHS-V rounds (V302= 3). Unfortunately, as mentioned, this variable was no longer used in the DHS-VI round, so that the information is now missing for the younger cohorts.

DHS surveys distinguish between “modern methods”, “traditional methods”, and “folk methods” of contraception. The list of methods recorded in African DHS surveys is provided in Table 2, along with the number of surveys in which the method has appeared. In this report we focus on “modern methods”, because they clearly have the most influence on fertility trends. The definition and list of modern methods varies somewhat from country to country, and sometimes from survey to survey in the same country, depending on the availability of new methods and on coding procedures (some methods are lumped

together as “other modern methods”). The coding of some methods was sometimes inconsistent. This is particularly the case for “breastfeeding / lactational amenorrhea”, which can be classified either as a modern method or as a traditional method. In any case this analysis is based on the “modern method” recoding in the standard recode files based on variable “V302”.

Table 2. List of contraceptive methods recorded in African DHS surveys

| Category | Contraceptive method | Number of DHS surveys |
|--|-------------------------|-----------------------|
| Modern | Pill | 95 |
| | IUD | 95 |
| | Injections | 95 |
| | Male condom | 95 |
| | Female condom | 36 |
| | Female sterilization | 94 |
| | Male sterilization | 32 |
| | Norplant / Implants | 52 |
| | Diaphragm | 47 |
| | Foam, jelly, spermicide | 47 |
| | Monthly pill | 0 |
| | Emergency contraception | 0 |
| | Other modern methods | 42 |
| | Traditional | Long term abstinence |
| Periodic abstinence / Rhythm | | 95 |
| Withdrawal | | 95 |
| Breastfeeding / Lactational amenorrhea | | 36 |
| Other traditional methods | | 8 |
| Folk method | Any folk method | 91 |

Note: The list varies from country to country. Breastfeeding / Lactational amenorrhea is sometimes classified among the modern methods.

The analysis of contraceptive use by age and cohort in Africa is complex. The first feature is a marked age pattern to ever-use of contraception, and the second feature is major cohort trends. In a majority of countries only a small proportion of women used contraception before the first marriage (for avoiding a premarital birth), then the proportion of ever-users increases with age, following the desire first for spacing births and later for limiting family size. In this study the age and cohort patterns of ever-use of modern contraception are presented in detail for each country in Appendix B. A model converting period data into cohort estimates was developed for this study (see below).

Extent of contraceptive use

Since precise intervals of contraceptive use are not available in DHS surveys, a simple indicator of the extent of contraception was used: the ratio of current-use to ever-use at last survey. The higher this ratio, the more extensive is the use of contraception, and therefore the higher the proportion of the reproductive life span protected by modern contraception. This variable is a supplement to “ever-use,” which is the key factor for understanding fertility trends in Africa.

Urban residence

Area of residence (urban / rural) is taken as defined by the surveys (“V102” in DHS surveys, and “V702” in WFS surveys) for the calculations of urban and rural trends in marriage and contraceptive use.

Level of education

Level of education is measured by the mean number of years of schooling (“V133” in DHS surveys). For WFS surveys, the number of years of schooling is calculated from the level of education attained. Details on this variable are provided in DHS Analytic Studies 33 published in 2012 (Garenne, 2012).

3.3 Data Issues

There were no major data issues of age at marriage and contraceptive use found during this study. Various inconsistencies are noted in the country studies, however, without much importance for the main results.

3.4 Trends in Cohort Age at Marriage

Cohort median age at marriage was calculated for each yearly cohort available, for each country and for urban and rural areas separately. Results are shown in Appendix B, country by country. First, a graphic visual analysis of data points was conducted. In case of no trend, the average was kept. In case of a linear trend, a linear regression line was fitted. In case of more complex changes, a 2nd degree polynomial was fitted, or several linear trends were fitted depending on the country situation. For earlier cohorts, trends were prolonged backwards when a significant trend was visible. Most often, however, the median age at marriage was taken as constant for the earlier cohorts (e.g. < 1930). Urban and rural areas were analyzed separately in all countries investigated, since fertility trends differ markedly by urban or rural residence.

3.5 Converting Period Estimates of Contraceptive Use into Cohort Estimates

DHS surveys provide data on ever-use of contraception by age at survey and cohort of birth, but without the age at which respondents first used contraception, an omission which seriously limits the trend analysis. In a survey taken at time (t), cohort effects and age effects are mixed, usually producing a bell-shaped pattern. In all countries with two or more surveys, however, the cohort effects as well as the age effects were found to be regular, as shown in Appendix B. Several models were tried to convert age and period estimates into cohort estimates. After numerous trials, a simple conversion model was selected, linking in a cohort the proportion of women who ever used contraception by age (x) to the same proportion at age 40 and above. This relationship was obtained by matching the same cohorts in different surveys of the same country. The final model was:

$$\text{Logit}(P(40)) - \text{Logit}(P(x)) = \beta \times (40 - x)$$

In this equation, x is age below 40, and P(x) the proportion of women who ever-used contraception by age x. The β coefficient was estimated from empirical data ($\beta = 0.10403858$).

The main advantage of this model is to allow a simple and consistent conversion of period estimates into cohort estimates. The main limitation is that it assumes the same age pattern in all countries, and therefore requires some adjustment to match observed and reconstructed period estimates. This adjustment was done by applying a multiplicative coefficient, matching the reconstructed period estimates with the observed period estimates at the first survey available.

Once cohort estimates were calculated for each cohort, each country, and urban and rural areas separately, cohort trends were smoothed by a five-year moving average. Earlier cohorts not covered by DHS surveys were obtained by prolonging trends backwards, and usually taken as zero for cohorts born before 1930.

3.6 Estimating the Average Age Pattern of Contraceptive Use

The average underlying age pattern of contraceptive use was calculated by linear-logistic regression, after controlling for cohort effects, using all surveys available. The equation was:

$$\text{Logit}(P(x)) = B0 + B1 \times \text{Cohort} + B2 \times \text{Age} + B3 \times \text{Age}^2$$

The regression model was calculated for urban and rural areas separately. This age pattern was smoothed with a Picrate Model in order to estimate the mean age at onset of contraceptive use (for details on the procedure, see Matthews et al., 2010).

3.7 Period Estimates Reconstructed from Cohort Data

This analysis includes formal cohort analysis and longitudinal analysis from reconstructed periods (synthetic cohorts). The method for calculating period data from reconstructed cohorts has been explained in DHS Analytical Studies 33 for level of education (Garenne, 2012). In brief, the period age at marriage to be matched with period fertility is recalculated from the cohort data by applying an age pattern of fertility to women of the corresponding age. This gives a measure of the median age at marriage for the synthetic cohort of women who gave birth in a given year.

In formula this gives:

$$\text{AgeMarriage}(t) = \sum_{a=15}^{49} \text{Agem}(a,t) \times f(a)$$

Where $f(a)$ is the age pattern of fertile women, defined by age-specific fertility rates, with $\sum f(a) = 1$, and $\text{Agem}(a,t)$ is the median age at marriage of cohort age (a) at time (t). Synthetic cohort estimates of median age at marriage were calculated for each year between 1950 and 2005, separately for urban and rural areas in each country.

The age patterns of fertility used for this reconstruction were calculated for each country and for urban and rural areas separately from DHS survey data, and fitted with splines. Details have been presented previously (Garenne, 2012).

The same method was applied for contraceptive use. So, the “Age-Standardized-Contraceptive Use” (ASCU) for period (t) was defined the same way:

$$\text{ASCU}(t) = \sum_{a=15}^{49} \text{ContraceptiveUse}(a,t) \times f(a)$$

Where $f(a)$ is the age pattern of fertile women, defined by age-specific fertility rates, with $\sum f(a) = 1$, and $\text{ContraceptiveUse}(a,t)$ is the proportion of women age (a) at time (t) who ever used contraception. This could be computed from reconstructed cohort data, or for the years in which a survey was taken, directly from survey data. Period estimates of ASCU were calculated for each year between 1950 and 2005, separately for urban and rural areas in each country.

3.8 Other Data Used

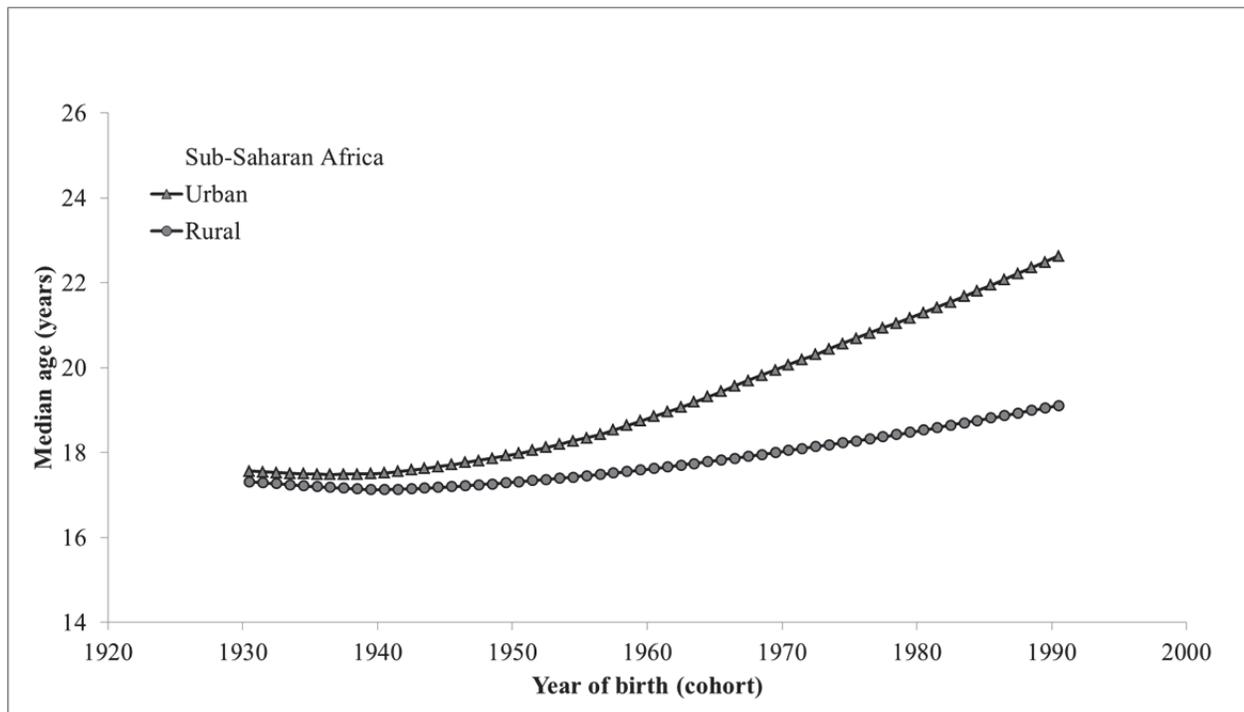
While most of this analysis was based on DHS data, the analysis also used other sources. Data on urbanization were taken from the United Nations Population Division database in its latest revision (2012). They were used for computing country estimates (urban and rural areas together) from proportions living in urban and rural areas in each year from 1950 to 2005. Data on income per capita were taken from the database assembled by Angus Maddison and colleagues, in its latest version (Maddison, 2008). This database provides estimates of Gross Domestic Product in Parity Purchasing Power (GDP-PPP) expressed in constant US dollars. The data are available for all African countries investigated, and for the 1950-2008 period. In this database, Ethiopia and Eritrea were merged together, so that the GDP for Ethiopia and Eritrea was considered that of Ethiopia, which is taken as a separate country in DHS surveys.

4. Trends in Age at Marriage

4.1 Long-Term Trends in Cohort Age at Marriage

Overall, for the 33 countries investigated, the cohort median age at first marriage increased markedly in urban areas, and somewhat less in rural areas. In urban areas, it increased by about 5 years, from an estimated value of 17.6 years for cohorts born in 1930 to 22.6 years for cohorts born in 1990, although this value was based on extrapolations for some Southern African countries. In rural areas the increase was about a third of the urban value (+1.8 years), from an estimated value of 17.3 years for the 1930 cohort to an estimated 19.1 years for the 1990 cohort. As a result, the gap in age at marriage between urban and rural areas increased markedly, which has been noted by many analysts in DHS country reports (Figure 2).

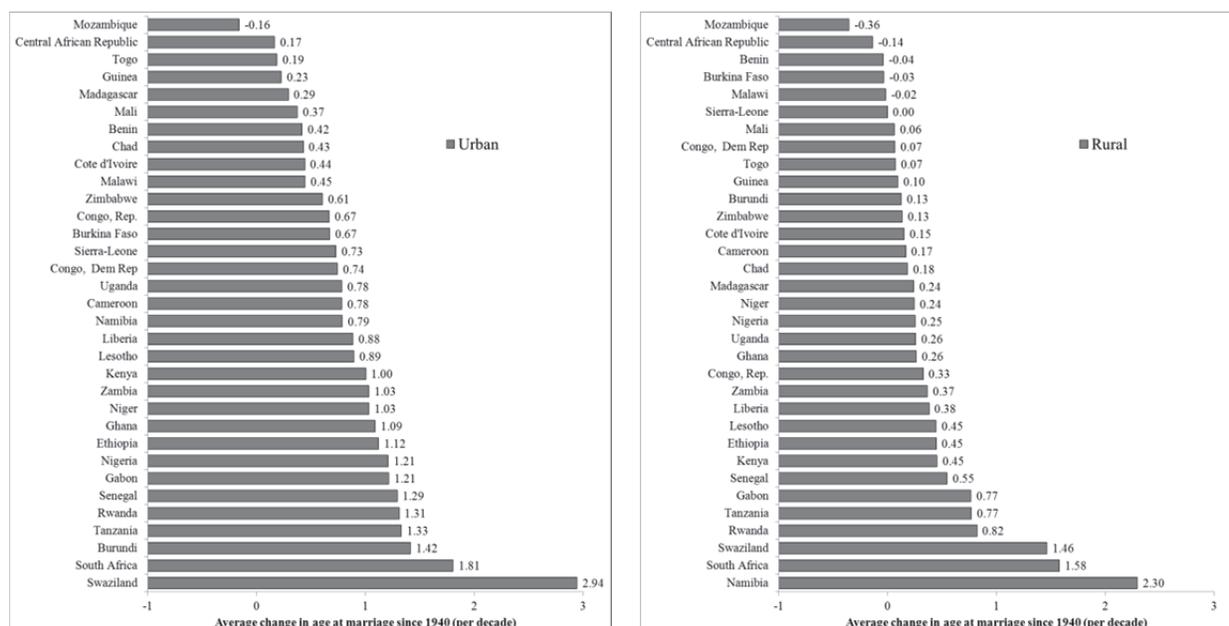
Figure 2. Reconstructed trends in cohort median age at marriage, 33 African countries



4.2 Country Variations in Age at Marriage since 1940

Changes since 1940 in age at marriage varied substantially among the 33 countries. Changes were computed as the estimate for the last cohort available minus the estimate for the 1940 cohort, and expressed in years per decade. Some countries had hardly any change in age at marriage, whereas in others changes were dramatic (Figure 3). The countries where age at marriage increased the most were in Southern Africa (South Africa, Namibia, and Swaziland), while changes were less marked in Lesotho, selected countries in Eastern and Central Africa (Tanzania, Gabon, Rwanda, Burundi, Ethiopia, and to a lesser extent Zambia and Kenya), and selected countries in West Africa (Senegal, Nigeria, urban Niger, and rural Liberia).

Figure 3. Average change in median age at marriage since cohort 1940 (years per decade)



In contrast, some countries had only very small or no increases in the median age at marriage: Central African Republic, Chad, Togo, Benin, Mali, Guinea (urban), Madagascar (urban), Burkina Faso (rural), and Malawi (rural). The case of Mozambique is peculiar, since age at marriage decreased markedly from cohorts 1940-1970 in both urban and rural areas before increasing again. In Madagascar, age at marriage first increased, then decreased (see Figures in Appendix B).

Some countries had divergent trends in urban and rural areas, in particular countries with rapid increases or erratic changes in urban areas but no change in rural areas (Benin, Burkina Faso, Burundi, Côte d'Ivoire, Sierra Leone, and Zimbabwe). In one country (Namibia) median age at marriage became higher in rural areas than in urban areas among recent cohorts. As a result, Namibia is now the country with the highest level of premarital fertility (Garenne and Zwang, 2005).

4.3 Reversals in Age at Marriage Trends

Trends in age at marriage varied by country. While an increase in age at marriage occurred at some point in urban areas of all 33 countries investigated, there was no increase in rural areas of 15 of the 33 countries studied. Some 12 countries showed a mild decline for the earlier cohorts (e.g., those born before 1950), and some 7 countries showed stagnation in age at marriage or even a reversal after age at marriage had first increased. (Details are shown in Appendix B.)

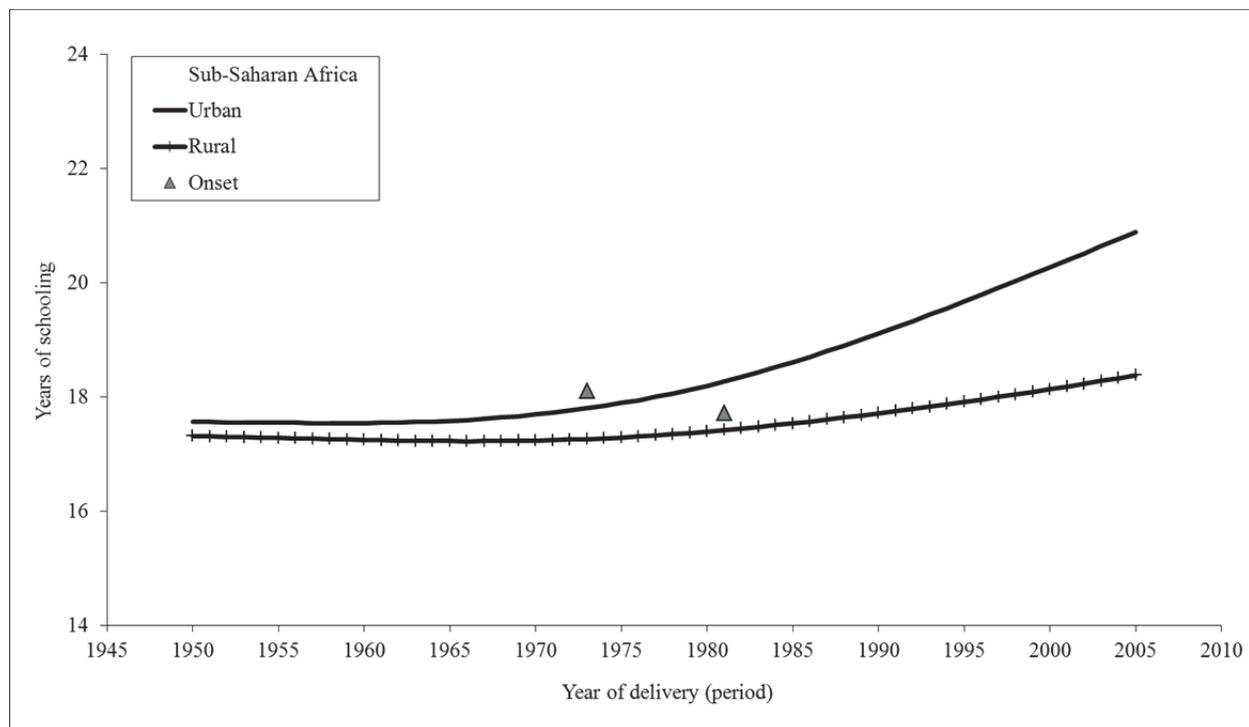
The most striking long-term reversals in age at marriage were found in the following countries: Congo-Brazzaville, in both urban and rural areas for cohorts born after 1975; Côte d'Ivoire, in urban areas for cohorts born after 1975; Madagascar, in both urban and rural areas for cohorts born after 1970; Mali, in urban areas for cohorts born after 1980; and Tanzania, in rural areas, for cohorts born after 1980. In rural Mali and rural Tanzania the decline in age at marriage was associated with a decline in the level of education. In urban Madagascar and in urban Mali the decline in age at marriage occurred despite an increasing level of education. In Congo-Brazzaville and in Côte d'Ivoire decline in age at marriage occurred while the level of education remained unchanged.

In addition to changes in long-term trends, trends in age at marriage were seriously disrupted in two countries affected by civil wars: Rwanda and Sierra Leone. In Rwanda age at marriage increased markedly for cohorts reaching marriage age during the early civil war years (1990-1994), but decreased shortly afterwards, probably because many women who did not marry during the crisis years did so when the situation became more stable. These changes could be seen by calculating period first marriage rates from DHS data, which showed a major increase in marriage rates in the two years following the April 1994 genocide (see Appendix B, Figure B-24.4). Similar trends in cohort age at marriage could be seen in Sierra Leone, although they affected only urban women, and not rural women. However, in Sierra Leone there was no evidence of change in period first marriage rates.

4.4 Period Trends in Age at Marriage

Period trends in age at marriage represent the average median age at marriage for the synthetic cohort who gave birth in each year. Results indicated a similar rise in age at marriage in both urban and rural areas, with a similar difference between both areas, and a smaller magnitude of change compared with cohort trends, due to the smoothing effect of merging different cohorts in a same time period (Figure 4).

Figure 4. Reconstructed trends in median age at marriage of synthetic cohorts, 33 African countries



In urban areas, age at marriage was low and similar to that in rural areas in 1950 (17.6 years in urban and 17.3 years in rural areas). Thereafter, age at marriage increased more in urban than in rural areas. In urban areas, it increased especially after 1965, reaching 20.9 years in 2005; in rural areas, it increased especially after 1975, reaching 18.4 years in 2005. These rather minor changes were unlikely to induce any major change in fertility in rural areas, and were expected to have only a small effect in urban areas. Note that the onset of fertility decline occurred at a low level of age at marriage in both urban and rural areas.

4.5 Trends in Fertility and in Age at Marriage

Fertility trends for urban and rural areas were presented in detail in an earlier study (Garenne, 2008). In this study, they are analyzed in correlation with trends in age at marriage. Here again, the approach was longitudinal, so that changes in age at marriage were matched with changes in fertility over the same period of time. The age at marriage in a given year for women who gave birth was computed as the weighted average of the age at marriage for the same cohorts, the weights being the age pattern of fertility, as explained above (see § 3.8).

Changes in age at marriage were computed as the difference between median age at marriage at the last point available (e.g. 2005 or last survey available) and the median age at marriage at the date of onset of fertility decline, defined for each country, and for urban and rural areas separately. Changes in age at marriage were correlated with changes in fertility over the same period of time. Both changes in age at marriage and in fertility were calculated as the average change per decade (number of children per decade for fertility; number of years per decade for age at marriage).

Results showed no correlation between changes in age at marriage and speed of fertility decline, and this was true both in urban areas ($\rho = -0.15$), and in rural areas ($\rho = +0.16$). One could find fast and slow fertility declines whether or not age at marriage had changed, and independently from the speed of the change (Figures 5 and 6).

Figure 5. Correlation between change in age at marriage and fertility decline, urban areas

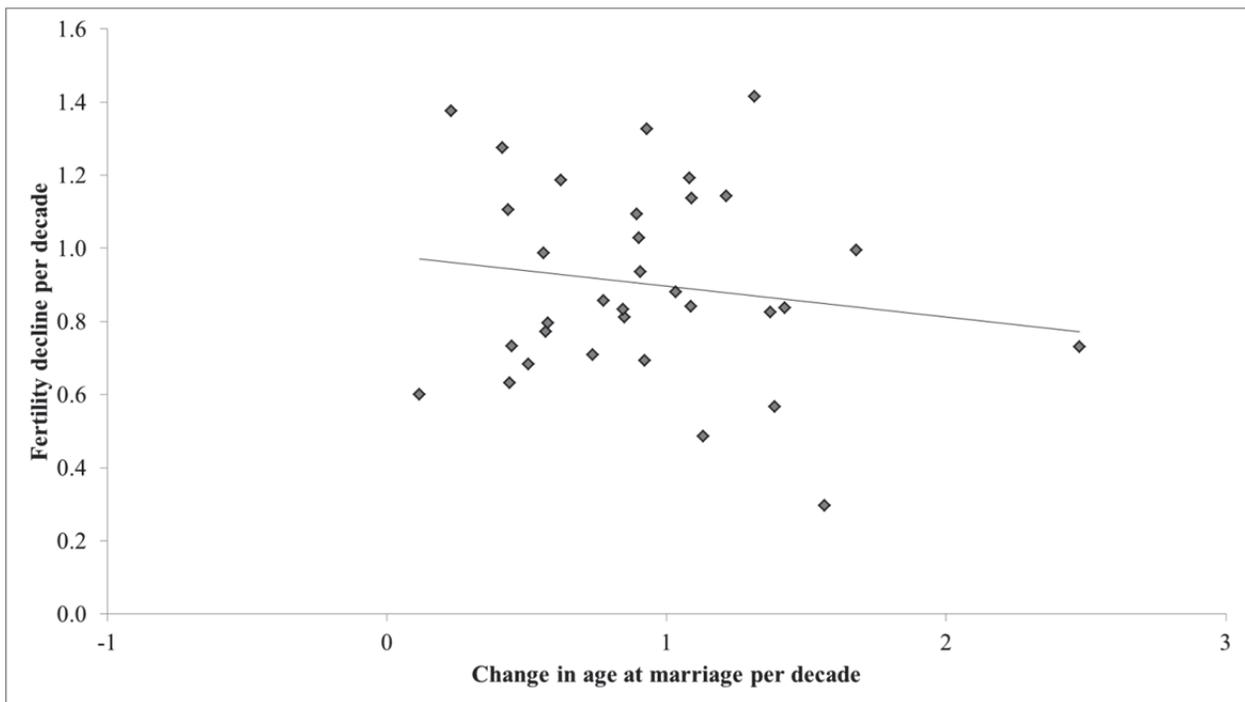
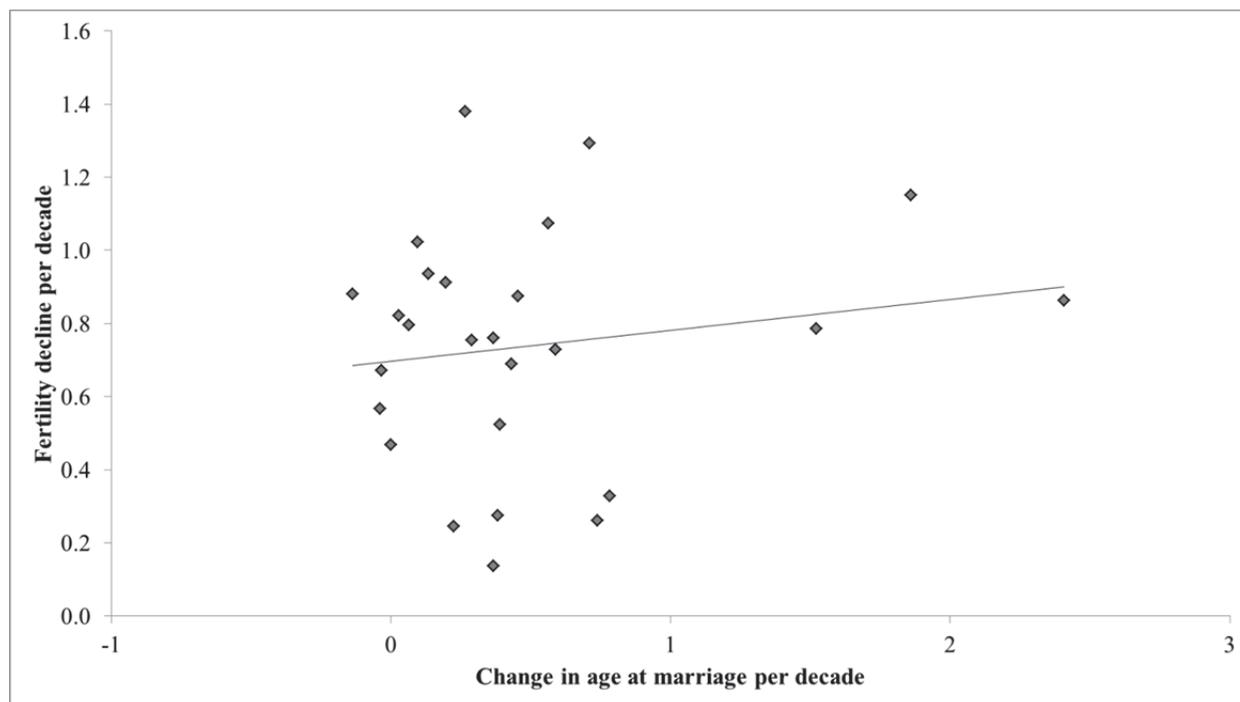


Figure 6. Correlation between change in age at marriage and fertility decline, rural areas



4.6 Reversal in Age at Marriage and Fertility Trends

Cases of reversal in cohort age at marriage, documented above, were analyzed for their possible effect on fertility trends. In Congo-Brazzaville the decline in age at marriage for cohorts born after 1975 translated into a decline in period age at marriage after 2000 in urban areas, and after 1997 in rural areas, but this did not alter fertility trends, which continued to decline in urban areas, and to increase in rural areas. In urban Côte d'Ivoire the decline in age at marriage for cohorts born after 1975 translated into stagnation in period age at marriage after 2002, but did not seem to have an effect on fertility trends which continued to decline in urban areas up to 2005. In Madagascar the decline in age at marriage for cohorts born after 1970 translated into a decline in period age at marriage after 1995 in urban areas, and stagnation after year 2000 in rural areas; this did not change the declining fertility trends in either urban or rural areas. In urban Mali the decline in age at marriage for cohorts born after 1980 translated into stagnation in period age at marriage after 2000, but had no effect on fertility trends which continued to decline. In rural Tanzania, the decline in age at marriage for cohorts born after 1980 translated into stagnation in period age at marriage after 2000, but did not seem to affect fertility trends which showed a small negative slope.

Overall, this lack of effect of marriage trends on fertility trends was largely expected: a change in cohort trends, even when impressive such as that in Madagascar, translated into a minor change for the situation of fertile women (the period estimate), and was unlikely to have any large effect on period fertility, mostly because the period changes were small and gradual.

4.7 Effect of Severe Crises on Age at Marriage and Fertility

The two cases of severe civil unrest were different, and showed different phenomena, which were primarily period effects. In Rwanda, the troubled 1990s had an effect on both marriage and fertility. In the two years following the genocide (1994-1995), first marriage rates increased by 73% (158 first marriages

per 1,000 person-years at age 14-29, compared with 93 per 1,000 expected from trends (P value $< 10^{-10}$). (See also Figure B-24.4 in Appendix B.) This short-term increase in first marriage had an impact on birth rates, which also increased during the same years.

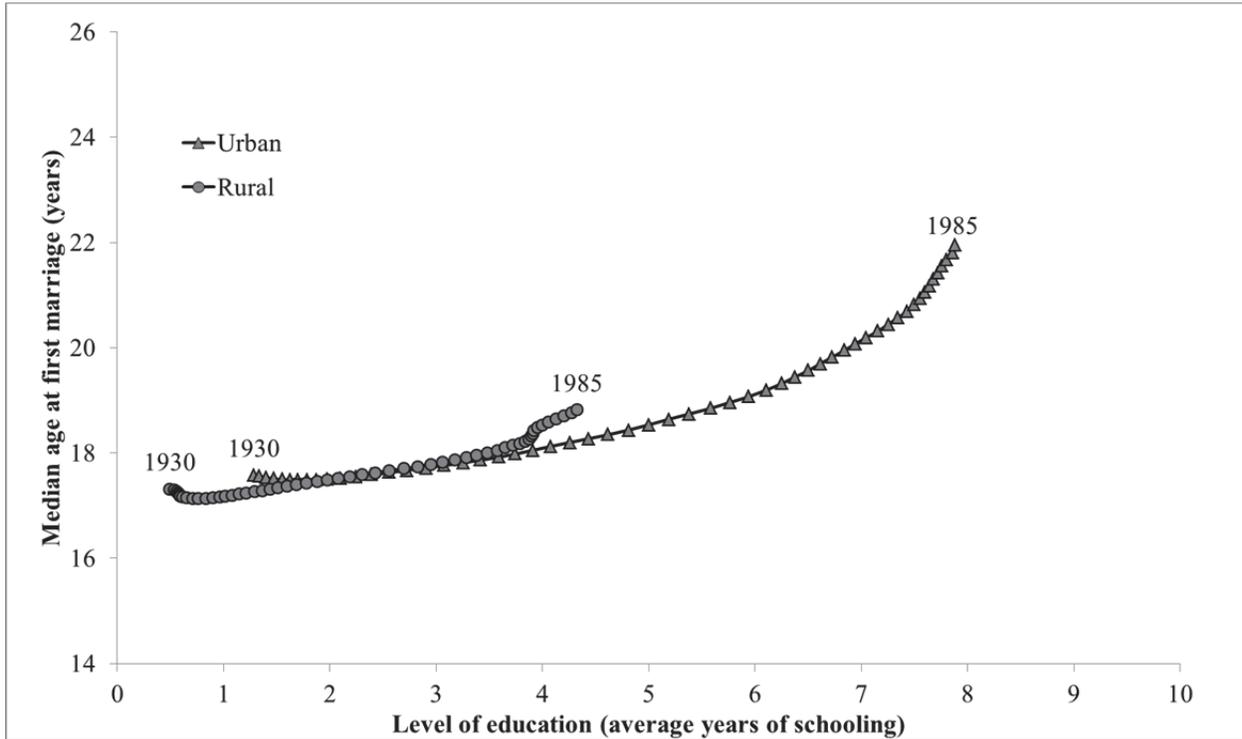
In contrast, in Sierra Leone, no effect of the civil war (1991-2000) was visible on first marriage rates, as noted above. With respect to fertility, trends were hardly changed during the war years, but fertility was 27% higher at the end of the civil unrest (2000-2002) compared with the average of the years before (1994-1999) and after (2003-2008), and this was true in both urban and rural areas. This rise in fertility, however, occurred without any evidence of an increase in marriage rates (167 first marriage per 1,000 person-years before 2000, and 172 per 1,000 in 2000-2002). This could be due to spousal separation during the crisis years followed by reunion thereafter, or simply by deliberate attempts to postpone births during the crisis years.

4.8 Overall Trends in Age at Marriage and in Education

The relationship between trends in age at marriage and trends in level of education was analyzed by matching the cohort median age at marriage with the cohort average years of schooling in a dynamic way. The country dynamics are presented in Appendix B.

Overall for the 33 countries combined, for the 1930-1985 cohorts, the dynamics of age at marriage and level of education appeared correlated: both increased in parallel, in urban as well as rural areas. In urban areas, when level of education increased from 1.3 to 7.9 years, median age at first marriage increased from 17.6 to 22.5 years; in rural areas changes were less striking: when level of education increased from 0.5 to 4.5 years, age at marriage increased from 17.3 to 19.1 years. However, the relationship was not linear, and in particular the increase in age at marriage was faster in the later years than before, and in urban areas it seemed to continue despite stagnation in the level of education, which indicates that other mechanisms were operating (Figure 7).

Figure 7. Dynamics of cohort age at marriage and cohort level of education, 33 African countries, cohorts 1930-1985



4.9 Diversity in Dynamics of Age at Marriage and Level of Education

Beyond the overall pattern, the dynamics of age at marriage and level of education were complex and not monotonic in many of the countries studied. Changes were monotonic or quasi-monotonic in 10 countries for urban areas, and in 19 countries for rural areas. The most common outstanding pattern was an increase in age at marriage despite stagnation or a decrease in level of education (15 cases in urban areas, 8 cases in rural areas). One could also find cases of a decline in age at marriage despite an increase in level of education (6 cases in urban areas, 4 cases in rural areas). The last two cases of serious disruption due to civil wars (Rwanda and Sierra Leone) were described above. Note that, as was the case for fertility trends, the dynamics of age at marriage and level of education were often different in urban and rural areas (16 out of 33 countries) (Table 3).

Table 3. Distribution of African countries according to the type of correlation between dynamics of level of education and dynamics of age at marriage

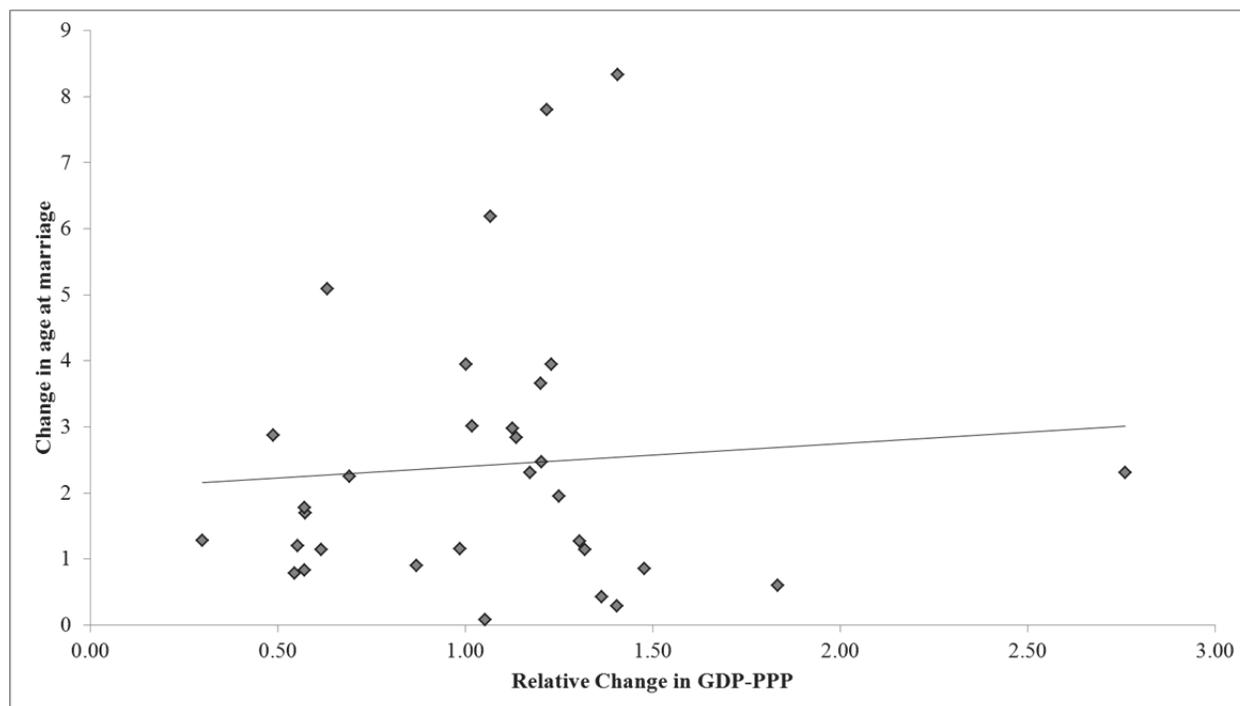
| Type of change | Urban | Rural | Different dynamics |
|----------------|-------|-------|--------------------|
| Monotonic | 10 | 19 | |
| Reversed | 15 | 8 | |
| Inversed | 6 | 4 | |
| Complex | 2 | 2 | |
| Total | 33 | 33 | 16 |

Note: (1) Monotonic: both level of education and age at marriage increase at the same time; (2) Reversed: age at marriage increases despite stagnation or decline in level of education; (3) Inversed: age at marriage declines while level of education increases; (4) Complex: complex changes due to wars of civil unrest; (5) Different dynamics: correlation differed between urban and rural areas.

4.10 Correlation between Changes in Age at Marriage and Changes in GDP

Changes in income per capita (measured by GDP-PPP in constant US Dollars) contrasted among African countries, with cases of steady increase (as in Lesotho), cases of stagnation (as in Senegal), and numerous cases of major recessions. To determine the economic conditions prevailing at time of marriage, income per capita at time (t) was matched with median age at marriage for cohort (t-20). Changes in income per capita between 1970 and 2005 (many of them negative) were matched with changes in median age at marriage for cohorts born between 1950 and 1985. Results showed virtually no correlation, meaning that changes in age at marriage were largely independent of economic development for these cohorts. One could find large or small increase in age at marriage at all levels of economic development, and whatever the income dynamics. The large increases in age at marriage were all associated with positive economic growth (all countries from Southern Africa), but the largest increases in GDP were not associated with the largest increases in age at marriage, and the largest decreases in GDP were not necessarily associated with stagnation or declines in age at marriage (Figure 8).

Figure 8. Correlation between changes in income per capita and change in age at marriage



The two cases of serious decline in cohort age at marriage were associated with serious economic downturn during the marriage years of the corresponding women. In Congo Brazzaville median age at marriage declined from 22.2 years (cohort 1972) to 20.4 years (cohort 1986), while GDP declined by 28%, from US\$ 3,008 (year 1984) to US\$ 2,159 (year 2008). In Madagascar median age at marriage declined from 19.1 years (cohort 1967) to 18.0 years (cohort 1988), while GDP declined by 53%, from US\$ 1,246 in 1971 to US\$ 664 in 1996.

Some of the peculiar patterns of the relationship between education and age at marriage (see above § 4.9) were analyzed with respect to income dynamics. Overall the patterns across countries were mixed. However, some cases of unexpected change in age at marriage could be related to socio-political events. For instance, in Ghana the fast increase in age at marriage for urban cohorts 1960-1971, given the level of education, seemed associated with the economic crisis of 1978-1983. In Liberia the increase in age at marriage for urban cohorts 1971-1976, given the level of education, seemed associated with the civil war. In Madagascar the decrease in age at marriage for cohorts born after 1965, given the level of education, seemed associated with the economic recession that started around 1975 and lasted for some 20 years.

Outside severe crises, the relationship between level of education and age at marriage could go either way with respect to economic growth. Cases of increasing age at marriage despite no change in level of education could occur in cases of economic recession (6 cases), economic growth (4 cases), or economic stagnation (4 cases). Cases of declining age at marriage despite increasing level of education could occur in situations of economic growth (2 cases) or economic recession (2 cases). The analysis of these surprising cases requires further investigation and detailed case studies.

4.11 Conclusions on Trends in Age at Marriage

In conclusion, trends in age at marriage and their consequences for fertility appeared far more complex than anticipated, and different from what is usually found in cross-sectional studies. Numerous cases were found of increase in age at marriage without evidence of increase in level of education, and conversely, cases of stable age at marriage despite increases in level of education. As shown earlier for the dynamic relationship between level of education and fertility, the dynamic relationship between age at marriage and fertility appeared very weak at the aggregate level, in fact virtually non-existent, contrary to the findings of most cross-sectional studies based on individual data.

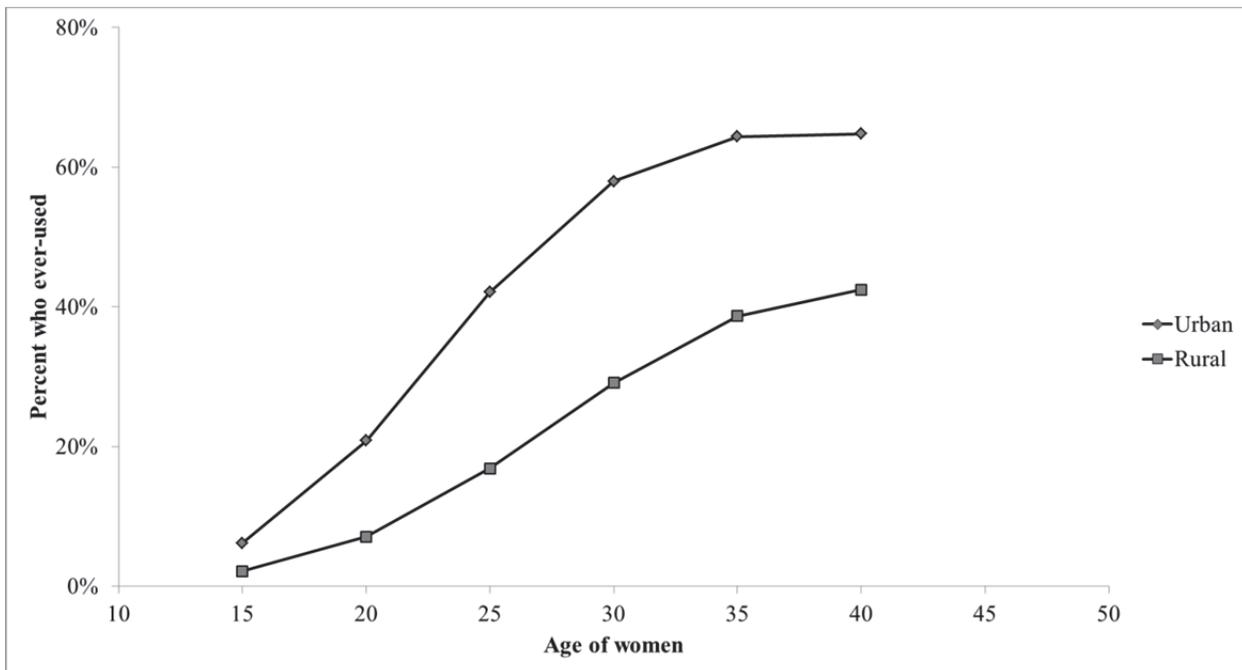
5. Trends in Contraception

This section is devoted to the reconstruction of trends in contraceptive use and their relationship with fertility trends. Contraceptive use is defined as the proportion of women who ever-used contraception by age 40, and is standardized by the age pattern of fertility. Fertility is defined as the cumulated fertility by age 40, as explained in another document (Garenne 2008).

5.1 Age Pattern of Ever-Use of Contraception

The regression model linking age and cohort estimates provided an average age pattern of entry into modern contraceptive use, after controlling for cohort effects. Results are displayed in Figure 9. For a given level of ever-use of contraception by age 40 and above, entry into contraceptive use was gradual, in both urban and rural areas. In urban areas, for an ultimate value of 64.8% ever-used of contraception at age 40 and above, the proportion of women who ever-used contraception was 20.9% at age 20, and 58.0% at age 30, so that the great majority of women (90%) who ever-used contraception began use before age 30.

Figure 9. Underlying average age pattern of ever-use of modern contraception, 33 African countries (from linear logistic regression, after controlling for cohort)

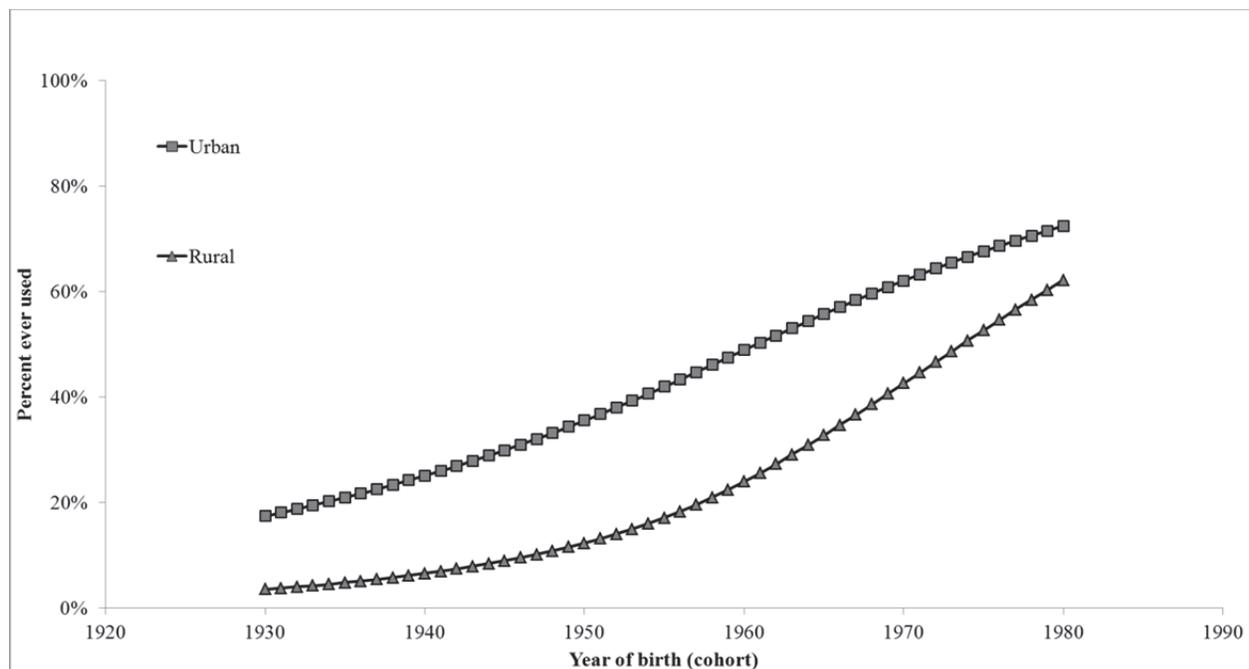


In contrast, in rural areas corresponding values were 42.5% ever-use at age 40 and above, for 7.1% at age 20 and 29.1% at age 30, so that only 69% of rural women who ever used modern contraception did so before age 30. This late entry into contraceptive use obviously is likely to have an effect on fertility trends. The average age at onset of contraception was estimated using a Picrate model, a simple parametric model used for fitting proportions of ever-married women (for details on the model, see: Matthews et al. 2008; Garenne et al., 2011). Results gave an average age at first use of contraception of 24.5 years in urban areas (standard deviation= 7.9 years) and 30.9 years in rural areas (standard deviation= 11.3 years).

5.2 Reconstructed Cohort Trends in Ever-Use of Contraception

Cohort trends in ever-use of modern contraception were reconstructed from period observed values and the age pattern, for each country and for urban and rural areas separately. They provide an estimate of the proportion of women who had ever-used a modern method (for the older cohorts) or will eventually ever-use one (for the younger cohorts) by age 40. For urban areas, this proportion increased from 17.4% for cohorts born in 1930 to 72.4% predicted for cohorts born in 1980. For rural areas, the proportion increased from only 3.4% for cohorts born in 1930 to a 62.1% predicted in 1980. Contraceptive use started later in rural areas, then appeared to catch up. However, the most recent estimate for the 1980 cohort is net of age effects. With the age effect presented in the previous paragraph, the real level of ever-use of contraception is much lower (Figure 10).

Figure 10. Underlying cohort trends of ever-use of modern contraception, net of age effect, 33 African countries (from linear logistic regression, after controlling for age)

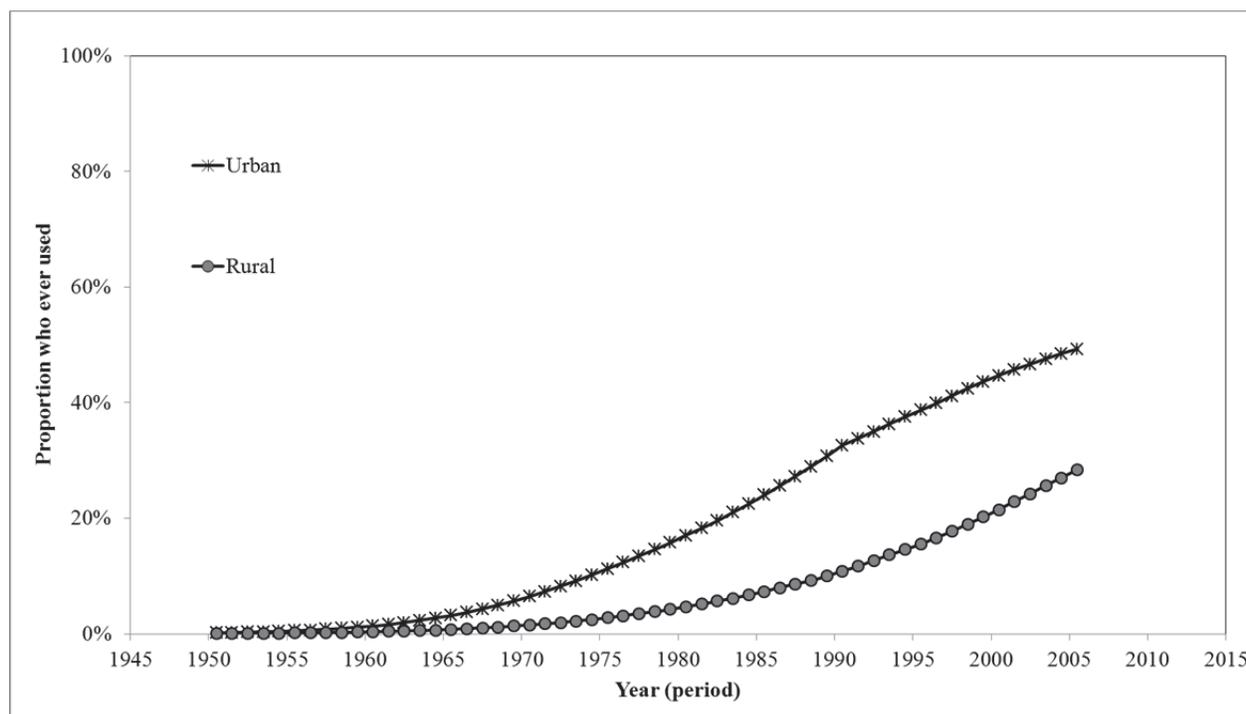


5.3 Trends in Period Ever-Use of Contraception

After smoothing cohort trends country by country, period trends were calculated for the older cohorts, and transformed into period trends for the earlier years, as explained in the methods section (see Chapter 3). They were matched with real period estimates drawn directly from the DHS surveys. A few inconsistencies were corrected in order to match values of age-standardized proportions of women who ever-used contraception calculated from cohort trends with the direct period estimate of ever-use from the earliest survey available in each country.

Results confirmed that overall use of modern contraception was close to zero in 1950. In urban areas it started to increase around 1965 and rose to reach about half of women (49.3%) in 2005. In rural areas, the increase started some 10 years later and rose to 28.4% in 2005. These levels of ever-use of modern contraception are realistic, and are all validated by the most recent survey available in each country (Figure 11).

Figure 11. Reconstructed trends in age-standardized ever-use of modern contraception of synthetic cohorts, 33 African countries

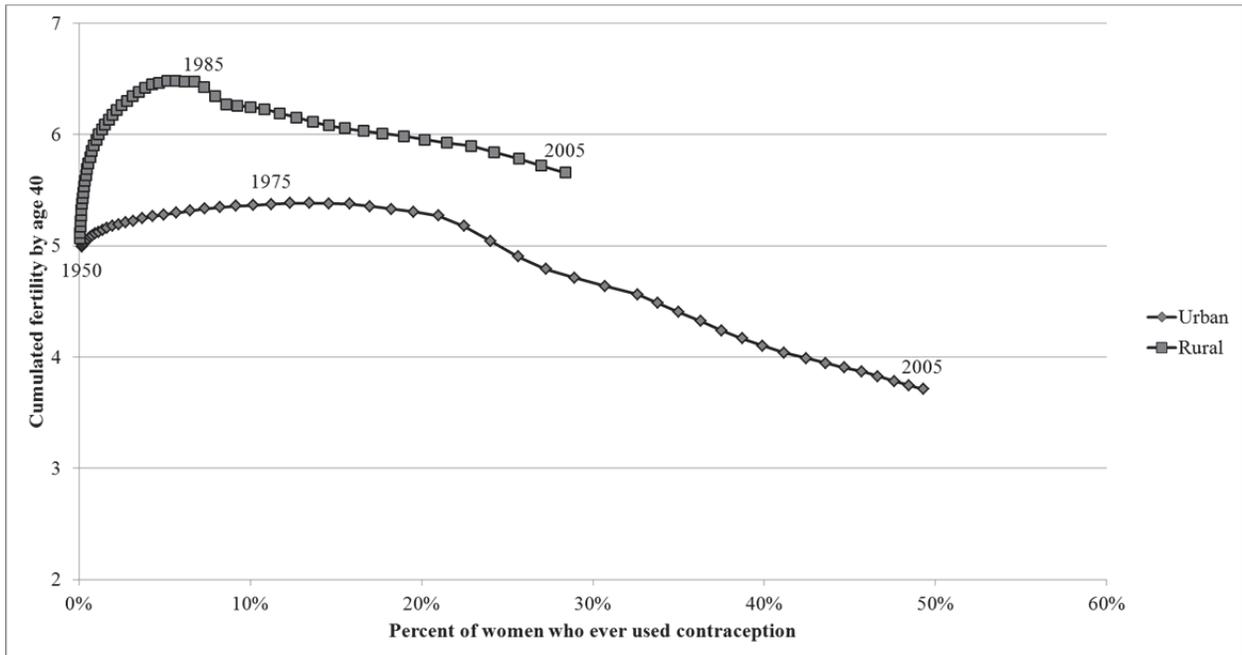


5.4 Trends in Fertility and Contraception

Period trends in ever-use of modern contraception were matched with period trends in fertility, already estimated from previous work (Garenne, 2008). Here the level of fertility is estimated by cumulated fertility by age 40, which in Africa is close to 90% of the TFR (cumulated fertility by age 50). Results allowed reconstructing the path of the fertility transition according to levels of contraceptive use (Figure 12). In the first years after 1950, fertility continued to increase despite a small increase in modern contraceptive use, simply because of increasing natural fertility. By 1975, fertility stabilized in urban areas at about 5.4 children per woman, when contraceptive use was limited (11%), then started to decline. By 2005, cumulated fertility by age 40 was 3.7 children per woman, when contraceptive use was 49.2%. This means that half of the fertility transition (from 5.4 to 2.0 children by age 40) was achieved with about half of women using modern contraception, and that contraceptive use has the potential of explaining the fertility decline. This result, which was obtained by two independent calculations, is remarkable, and confirms the high consistency between fertility and contraception data in DHS surveys, and the apparent high efficacy of contraceptive use in urban areas. However, this effect was reduced by the relatively low ratio of current-use to ever-use, 45.2% on average. Only about half of the fertility transition in urban areas can be explained by modern contraceptive use.

In rural areas the results were less consistent. The fertility decline was only 14% (from 6.3 to 5.7 children per woman) while some 28% of women ever-used modern contraception by year 2005. This discrepancy could be due to the later age at first contraceptive use, as noted above. Again, contraceptive use had the potential to explain most of the fertility decline, but the effect was reduced by a relatively low ratio of current-use to ever-use, 40.6%. A large share of the early fertility transition in rural areas can be explained by modern contraceptive use.

Figure 12. Reconstructed path in ever-use of contraception and fertility of synthetic cohorts, 33 African countries, 1950-2005



5.5 Stagnation of Contraceptive Use and Fertility Stalls

Instead of a steady increase in modern contraceptive use, a number of countries exhibited some kind of stagnation or even a decrease in contraceptive use from one survey to the next (details are provided in Appendix B). For age-standardized ever-use of contraception measured at time of survey, significant declines were found in the following countries: urban Kenya (1998-2003); urban Malawi (2000-2004), urban and rural Mali (2001-2006), urban Niger (1998-2006), and urban and rural Rwanda (1992-2000). In urban Kenya (1995-2001) and in Rwanda (1991-1995), the reversals in ever-use of contraception were associated with fertility stalls, but this was not the case in the other countries. Of course, fertility stalls were more likely to be determined by current use of contraception rather than by ever-use (Table 4).

Table 4. Cases of reversal in age-standardized contraceptive use between successive surveys

| Country | Residence | Previous survey | | Next survey | | T-test | P-value | Impact on fertility |
|---------|-----------|-----------------|-------------|-------------|-------------|--------|---------|---------------------|
| | | Year | ASCU (/100) | Year | ASCU (/100) | | | |
| Kenya | Urban | 1998 | 55.9 | 2003 | 52.0 | -2.47 | 0.0134 | Stall |
| Malawi | Urban | 2000 | 53.4 | 2004 | 46.8 | -4.27 | 0.0000 | None |
| Mali | Urban | 2001 | 36.3 | 2006 | 29.8 | -6.39 | 0.0000 | None |
| | Rural | 2001 | 14.4 | 2006 | 12.0 | -4.81 | 0.0000 | None |
| Niger | Urban | 1998 | 34.0 | 2006 | 29.9 | -2.53 | 0.0114 | None |
| Rwanda | Urban | 1992 | 32.3 | 2000 | 27.8 | -1.77 | 0.0770 | Stall |
| | Rural | 1992 | 19.4 | 2000 | 14.1 | -8.44 | 0.0000 | Stall |

NB: ASCU = Age standardized ever-use of contraception.

5.6 Conclusions on Contraceptive Use

The increase in contraceptive use was impressive in Africa, although the increase was not as fast as desired, and was slower than in other developing countries, where virtually universal contraceptive use could be achieved in less than a generation. In sub-Saharan Africa, after some 40 years of family planning efforts, only half of urban women and hardly more than one-fourth of rural women had ever-used modern contraception. This has already been shown using cross-sectional data (Cleland et al., 2010).

6. Synthesis on the Longitudinal Relationships of Age at Marriage and Contraception on Fertility

This section presents an attempt to synthesize the effects of age at marriage and contraceptive use on fertility trends. Several linear regression models were explored linking fertility changes with changes in age at marriage and contraceptive use at country level. All models showed a small effect of age at marriage, and a large effect of contraception. The final model presented here produced the most consistent results in both urban and rural areas. It links the level of fertility at the endpoint with contraception and age at marriage after controlling for the level of fertility at the onset.

6.1 Basic Regression Model

The basic model is an application of standard regression models for longitudinal data, such as that described as “analysis of covariance model” by Winship and Morgan (1999). The model links fertility level at endpoint with modern contraceptive use at endpoint and with changes in age at marriage since onset, controlling for level of fertility at onset of the transition. The last control simply says that the effect of a given level of contraceptive use and of change in age at marriage depends on the level of natural fertility preexisting before the transition, which varies from less than 6 to more than 8 children per women in Africa. The endpoint was set as year 2005, or the date of the latest DHS survey available before 2005. The regression was based on 32 countries for urban areas and 28 countries for rural areas (Congo-Brazzaville, Congo-Kinshasa, Niger, and Uganda were excluded because fertility transition had not yet started in their rural areas).

Results confirmed that the effect of age at marriage was small and not even significant when urban and rural areas are considered separately. The net effect of contraceptive use at endpoint was strong and largely significant in both urban ($P= 0.002$) and in rural ($P= 0.008$) areas. This calculation assumes that the level of contraceptive use at onset was nil. The effect of the level of natural fertility at onset of fertility decline was not significant in urban areas, but was significant in rural areas. The net effect of contraceptive use was stronger in urban than rural areas, and this was true both in absolute and relative value, as was expected because of the later age at first use of contraception in rural areas. Overall, the net effect of ever-use of modern contraception explained some 50.9% of the change in fertility in urban areas, and only 41.4 % in rural areas. The net effect of change in age at marriage could only be small, with only a small contribution in both urban and rural areas compared with the overall change in fertility (Table 5).

Table 5. Results from the regression analysis linking fertility with ever-use of modern contraception and change in age at marriage (aggregate data)

| | Mean value | B coefficient | P-Value | Signif. | Net effect | Percent explained |
|----------------------------|------------|---------------|---------|---------|------------|-------------------|
| Urban areas (32 countries) | | | | | | |
| Fertility at end | 4.09 | | | | | |
| Fertility at onset | 6.91 | +0.3021 | 0.107 | NS | | |
| Ever-use at end | 0.510 | -2.8169 | 0.002 | * | -1.437 | 50.9% |
| Change in age at marriage | +2.74 | -0.0892 | 0.180 | NS | -0.244 | |
| Rural areas (28 countries) | | | | | | |
| Fertility at end | 5.95 | | | | | |
| Fertility at onset | 7.46 | +0.5315 | 0.006 | * | | |
| Ever-use at end | 0.318 | -1.9658 | 0.008 | * | -0.625 | 41.4% |
| Change in age at marriage | +1.09 | -0.1365 | 0.151 | NS | -0.149 | |

NB: (*) significant at $P < 0.05$; NS: Not significant

Model: $Fertility(t) = B0 + B1 \times Fertility(onset) + B2 \times Contraception(t) + B3 \times Change\ in\ age\ at\ marriage(t) + \epsilon$

6.2 Country Heterogeneity

The model was further developed to take into account the heterogeneity of the relationship by country, explored in the Appendix and documented above. This heterogeneity comes from the confounding factors of contraceptive use and age at marriage: the extent of contraceptive use, that is, the periods of use during the reproductive life span, including age at first use and the ratio of current-use to ever-use, and the level of premarital fertility. The basic model was extended and applied while adding a dummy variable for urban and rural areas and dummy variables for each country. In the regression models only few country coefficients were statistically significant. Among the consistent negative residuals, that is, the countries with lower fertility than predicted by the model, were Lesotho (residual= -1.09), Togo (-0.99), Zimbabwe (-0.98), Kenya (-0.96) and Ethiopia (-0.87). These countries achieved lower levels of fertility primarily because of higher use of contraception (more current-use per ever-use). In contrast, three counties exhibited positive residuals, that is, higher fertility than expected by the model: Congo-Brazzaville, Congo-Kinshasa, and Zambia. These are three countries in which the fertility transition had not yet started in rural areas. The addition of country dummy variables did not change the magnitude of the overall effects of age at marriage and contraceptive use on fertility decline.

6.3 Full model with Extent of Contraception and Premarital Fertility

The basic model was also extended by including the two confounding factors: one for contraception (the extent of contraception measured by the ratio of current-use to ever-use at the endpoint), and one for marriage (the extent of premarital fertility measured by the proportion of premarital births at the endpoint). The results confirm that a large share of the fertility decline can be explained by contraceptive use, and that age at marriage played a minor role (Table 6).

Table 6. Results from the regression analysis linking fertility with contraceptive use, age at marriage and confounding factors (aggregate data, urban and rural combined)

| | Mean value | B coefficient | P-Value | Signif. | Net effect | Percent explained |
|--------------------------------|------------|---------------|---------|---------|------------|-------------------|
| Fertility change | -2.210 | | | | | |
| Contraception | | | | | | |
| Ever-use at end | 0.421 | -2.270 | 0.0005 | * | -0.955 | 43.2% |
| Extent of contraception at end | 0.430 | -1.833 | 0.0240 | * | ±0.231 | ±10.5% |
| Marriage | | | | | | |
| Change in age at marriage | +1.971 | -0.104 | 0.131 | NS | -0.204 | |
| Premarital fertility at end | 0.132 | +1.038 | 0.398 | NS | +0.137 | |
| Controls | | | | | | |
| Natural fertility at onset | 7.165 | +0.510 | 0.0003 | * | | |
| Urban dummy | 0.533 | -0.935 | 0.0001 | * | | |

NB: (*) significant at $P < 0.05$, (NS) not significant. Linear regression model after controlling for level of fertility at onset of the transition and urbanization. Net effect of ever-use of contraception at endpoint. The “net effect” of contraception at the endpoint is the +/- effect of one standard deviation (+/-0.126).

The effect of ever-use of contraception remained stable, whatever control was added, explaining about half of the fertility decline (53.7% in urban, 36.4% in rural areas). Contraception played a moderating role around the mean. One standard deviation (+/-12.6%) adds or subtracts an additional +/- 10.5%, so that an average ever-use of contraception combined with extensive use (say 70% ever-use/current-use) can explain about two-thirds of the fertility decline (43.2% + 2×10.5%), whereas when combined with low use (say 20%), it can explain only a tiny fraction (about 22%).

When premarital fertility is added, the net effect of age at marriage is hardly changed. The effect of marriage remains statistically insignificant, in urban areas, in rural areas, and in both combined, whereas all other variables and controls remain highly statistically significant.

6.4 Univariate versus Multivariate Analysis

The aggregate regression model presented here shows only a limited impact of ever-use of contraception on fertility trends. This is in part due to heterogeneity and confounding factors. When combined with the extent of contraception, the proportion of fertility decline explained by the model increases. This observation matches with a previous observation in the univariate analysis: ever-use of contraception has the potential to explain all the fertility decline, since the proportion of women who ever-used modern contraception is similar (in urban) or exceeds (in rural) the percent of fertility decline. However, the net effect is reduced by the pattern of use of contraception over the life course, in particular by the age at first use and the continuity of use. If one takes the average empirical value of the extent of contraceptive use (45.2% in urban areas and 40.6% in rural areas) one finds again that about half of fertility decline can be explained by contraceptive use, given that a prevalence of about 80% is necessary for achieving a desired family size of two children.

The aggregate models also show consistently a minor impact of age at marriage on fertility trends. This can be compared with previous observations in the univariate analysis, and seems to be due to the small changes in marriage characteristics of the synthetic cohorts documented above, itself due to the mixing of cohorts in period data, and to increases in premarital fertility.

7. Discussion

7.1 Contraceptive Use

This study described trends in contraceptive use and their probable impact on fertility trends. Broadly speaking, the consistency between both trends was remarkable in urban areas: when half of women were using modern contraception half of the fertility transition was achieved. In rural areas, the relationship was weaker, probably because of later age at onset of contraceptive use. The full analysis of the relationship between contraception and fertility was limited by the lack of data, starting with missing information on age at first use, and ending with the dropping of the question on ever-use in the DHS-VI round.

In sub-Saharan Africa, the study of trends in contraceptive use was further complicated by marked age, period, and cohort effects. Entry into contraception appeared very gradual, and not as quasi-universal since first intercourse as in developed countries. Family planning programs were installed in sub-Saharan African countries at various points in time, leading to strong cohort effects. Women born early in the 20th century had virtually no access to modern contraception, whereas women born late in the 20th century generally had ample access. Large differences were found between urban and rural areas, leading to different dynamics, and different age patterns.

Beyond the spread of modern contraception among African women, the extent of contraceptive use, measured by the ratio of current-use to ever-use, appeared to play an important role on fertility decline. Some women probably used modern contraception for limited periods of time over their reproductive life span, while others probably used efficiently modern contraception when needed, achieving therefore low levels of fertility, as exemplified in numerous cases where the TFR is below three children per woman in urban areas. These periods of contraception deserve more investigation in the future, whether for avoiding a premarital birth, for spacing births, or for limiting family size.

7.2 Missing Information on Abortion

Although this study found consistent trends in contraception and fertility, ever-use and current-use of modern contraception did not explain all fertility declines in regression analysis. Several reasons could explain this discrepancy. First, data on contraception were limited, and the reconstruction of trends had problems, even though the beginning and the end were properly calibrated. Second, information on induced abortion was missing, and this could be an important element of fertility control in some countries, in particular in urban areas.

7.3 Other Proximate Determinants

This study deliberately ignored other factors of natural fertility, in order to focus on marriage and contraception. It should be recalled that, in many African countries, fertility was increasing in the 1950s, and probably even before then, for a variety of reasons. Little research has been conducted on trends in factors of natural fertility such as age at puberty, age at menopause and secondary sterility. If trends in these biological factors were favorable to fertility (earlier puberty, later menopause, less sterility), one could underestimate the effect of contraception by ignoring them.

Furthermore, other biological and behavioral factors of natural fertility could be interacting with fertility trends in the opposite direction. Little work has been conducted on recent trends in primary and secondary sterility due to emerging diseases. In particular HIV/AIDS, which is highly prevalent in many African countries, was found repeatedly to reduce fecundity, and could have had an effect on fertility trends.

Finally, changing behaviors could also interact. In particular, marital disruption or spousal separation associated with HIV/AIDS, with migration or with new forms of occupation for men and women could have an effect on coital frequency and therefore on fertility. These effects could also account for parts of the unexplained fertility decline identified in this study.

7.4 Marriage Trends

Trends in age at first marriage were found to be more complicated than expected with all possible permutations: little changes (no trend), regular increase, increase followed by decrease, and decrease followed by increase. Some of the unexpected trends could be explained by economic or political crises, while others remain to be further analyzed.

The relationship of age at marriage with female modern education, universally described in cross-sectional analysis, was found to be complex when viewed in a longitudinal perspective. Here again all possible interactions were found: regular increase in both education and age at marriage; no increase in age at marriage despite rising level of education; increase in age at marriage without changes in level of education; and various loops and reversals in either or both variables. This analysis showed one more time how misleading it can be to extrapolate results from cross-sectional surveys to longitudinal analysis.

This study considered only the first marriage, because information on marriage history was lacking in DHS surveys. Of course, the first marriage is only one element of marital life, and in some African countries divorce has become quite frequent, with long delays to remarriage, not counting widowhood associated with HIV/AIDS.

Several other factors could be interacting with fertility, particularly migration and female employment. Numerous cases of spousal separation have been reported throughout Africa, due to temporary or circular migration of husbands or wives, which may occur with new economic opportunities for both males and females. In these cases, spouses may appear as married in demographic surveys, but may be living apart and therefore unlikely to conceive.

7.5 Relation with Individual Data Analysis

An attempt was made to compare the results of the longitudinal analysis of aggregate data with a more conventional analysis of individual data. It was necessary to select cohorts of women already 40 years of age or older, but that seriously limited the analysis because it selected older cohorts who had barely entered the fertility transition. In a multivariate analysis linking children ever born with age at marriage and ever-use of modern contraception, the net effect of age at marriage was always significant. This reveals the effect of individual heterogeneity (women who marry later have fewer children), but not the effect of changing age at marriage on fertility trends, as shown in the aggregate data analysis.

7.6 Conclusion

This study provided a broad overview of the relationship between increases in use of modern contraception and fertility trends over a long period of time—more than half a century. This analysis was possible thanks to the demographic surveys conducted in most sub-Saharan African countries, despite the absence of reliable vital registration of live births, and despite lack of precise information on contraceptive use. This broad overview hides many details that need to be further analyzed at the country level, and possibly also for regions or ethnic groups within countries.

References

- Althaus, F. 1991. "Early Marriage and Childbearing Remain Common in Much of Developing World, Even as Fertility Falls." *International Family Planning Perspectives* 17(3): 119-120.
- Bledsoe, C.H., and G. Pison. 1994. *Nuptiality in Sub-Saharan Africa: Contemporary Anthropological and Demographic Perspectives*. Oxford, UK: Clarendon Press.
- Bongaarts, J. 1978. "A Framework for Analyzing the Proximate Determinants of Fertility." *Population and Development Review* 4 (1): 105-132.
- Bongaarts, J. 2006. "The Causes of Stalling Fertility Transitions." *Studies in Family Planning* 37(1): 1–16.
- Bongaarts, J. 2010. "The Causes of Educational Differences in Fertility in Sub-Saharan Africa." Population Council, Poverty, Gender and Youth, Working Paper # 20. New York, New York, USA: Population Council.
- Bongaarts, J. 2011. "Can Family Planning Programs Affect High Desired Family Size in Sub-Saharan Africa?" *International Perspectives on Sexual and Reproductive Health* 37(4): 209–216.
- Bongaarts, J., and J. Casterline. 2012. "Fertility Transition: Is Sub-Saharan Africa Different?" *Population and Development Review* 38(Supplement): 153–168.
- Bongaarts, J., O. Frank, and R. Lesthaeghe. 1984. "The Proximate Determinants of Fertility in Sub-Saharan Africa." *Population and Development Review* 10(3): 526.
- Bongaarts, J., and G.W. Jones. 1982. "Fertility Determinants: Proximate Determinants." In *International Encyclopedia of Population*, vol. 1, edited by John Ross, page 275 – 279, New York, New York, USA and London, UK: Macmillan Publishing Co, Inc.
- Bryant, J. 2007. "Theories of Fertility Decline and the Evidence from Development Indicators." *Population and Development Review* 33(1): 101–127.
- Burch, T.K. 1983. "The Impact of Forms of Families and Sexual Unions and Dissolution of Unions on Fertility." In *Determinants of Fertility in Developing Countries*, vol. 2: Fertility Regulation and Institutional Influences, edited by R.A. Bulatao and R.D. Lee, page 532-561, New York, New York, USA: Academic press.
- Caldwell, J.C. 1994. "Fertility in Sub-Saharan Africa: Status and Prospects." *Population and Development Review* 20(1): 179-187.
- 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.
- Casterline, J.B. 1999. *The Onset and Pace of Fertility Transition: National Patterns in the Second Half of the Twentieth Century*. Policy Research Division Working Paper No. 128. New York, New York, USA: Population Council.
- Castro-Martin, T. 1995. "Women's Education and Fertility: Results from 26 Demographic and Health Surveys." *Studies in Family Planning* 26(4): 187-202.

- Chimere-Dan, O. 1993. "Maternal Education and Marital Fertility in Four African Countries." *Genus* 49(3-4): 87-100.
- Cleland J.G, R.P. Ndugwa, and E.M. Zulu. 2010. "Family Planning in Sub-Saharan Africa: Progress or Stagnation?" *Bulletin of the World Health Organization* 89: 137-143.
- Cleland, J., N. Onuoha, and I. Timaeus. 1994. "Fertility Change in Sub-Saharan Africa: A Review of Evidence." In *The Onset of Fertility Transition in Sub-Saharan Africa*, edited by T. Loco and V. Hertrich. Liège, Belgium: Derouaux Ordina.
- Cleland, J., and G. Rodríguez. 1988. "The Effect of Parental Education on Marital Fertility in Developing Countries." *Population Studies* 42(3): 419-442.
- David, L. 1992. "Fertility and Family Planning in Southern and Central Africa." *Studies in Family Planning* 23(3): 145-158.
- Davis, K, and J. Blake. 1956. "Social Structure and Fertility: An Analytical Framework." *Economic Development and Cultural Change* 4(4).
- Dodoo, F.N.A. 1998. "Marriage Type and Reproductive Decisions: A Comparative Study in Sub-Saharan Africa." *Journal of Marriage and the Family* 60: 232-242.
- Garenne, M. 2004. "Age at Marriage and Modernization in Sub-Saharan Africa." *Southern African Journal of Demography* 9(2): 57-77.
- Garenne, M. 2008. *Fertility Changes in Sub-Saharan Africa. DHS Comparative Report No. 18*. Calverton, Maryland, USA: Macro International Inc.
- Garenne, M. 2009. "Situations of Fertility Stall in Sub-Saharan Africa." *African Population Studies* 23(2): 173-188.
- Garenne, M. 2011. "Testing for Fertility Stalls in DHS Surveys." *Population Health Metrics* 9:59.
- Garenne, M. 2012. *Education and Fertility in Sub-Saharan Africa: A Longitudinal Perspective*. DHS Analytical Studies No. 33. Calverton, Maryland, USA: ICF International.
- Garenne, M., and V. Joseph. 2002. "The Timing of the Fertility Transition in Sub-Saharan Africa." *World Development* 30(10): 1835-1843.
- Garenne, M., and J. Zwang. 2004. "Social Change and Premarital Fertility in Madagascar." *Southern African Journal of Demography* 9(1): 27-48.
- Garenne, M., and J. Zwang. 2005. "Premarital Fertility in Namibia: Levels, Trends and Factors." *Journal of Biosocial Science* 37(1): 1-23.
- Garenne, M., and J. Zwang. 2006. *Premarital Fertility and Ethnicity in Africa. DHS Comparative Reports No. 13*. Calverton, Maryland, USA: Macro International Inc.
- Garenne, M., P. Leclerc, and A. Matthews. 2011. "Parametrisation of the Transition to First Marriage with the Picrate Model: Application to African Countries Using DHS Surveys." *Southern African Journal of Demography* 12(1): 109-124.

- Garenne, M., S. Tollman, and K. Kahn. 2000. "Marital and Premarital Fertility in a Rural Area of South Africa: A Challenge to Existing Population Policy." *Studies in Family Planning* 31(1): 47-54.
- 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(Supp 69): 68-76.
- 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. 1960. "The Influence of Business Cycles on Marriage and Birth Rates." In *Demographic and Economic Change in Developed Countries*, edited by NBER, page 241-260, New York, New York, USA: Columbia University Press.
- 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.
- Kravdal, Ø. 2002. "Education and Fertility in Sub-Saharan Africa: Individual and Community Effects." *Demography* 39(2): 233-250.
- 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.
- Lloyd, C.B., C.E. Kaufman, and P. Hewett. 2000. "The Spread of Primary Schooling in Sub-Saharan Africa: Implications for Fertility Change." *Population and Development Review* 26(3): 483-515.
- Machiyama, K. 2010. *A Re-Examination of Recent Fertility Declines in Sub-Saharan Africa*. DHS Working Papers No. 68. Calverton, Maryland, USA: ICF Macro.
- Maddison, A. 2008. *Statistics on World Population, GDP and Per Capita GDP, 1-2008 AD*. Groningen, Netherlands: University of Groningen.
- Matthews, A., P. Leclerc, and M. Garenne. 2009. "The Picrate Model for Fitting the Age Pattern of First Marriage." *Mathématiques et Sciences Humaines* 47(2):17-28.
- Mbacke, C. 1994. "Family Planning Programs and Fertility Transition in Sub-Saharan Africa." *Population and Development Review* 20(1): 188-193.
- Ngom, P., and S. Fall. 2005. *Fertility Decline in Francophone Sub-Saharan Africa: 1980-2010*. APHRC Working Paper. Nairobi, Kenya: African Population and Health Research Center.
- Quisumbing, A.R., and K. Hallman. 2003. *Marriage in Transition: Evidence on Age, Education, and Assets from Six Developing Countries*. Population Council Working Paper No. 183. New York, New York, USA: Population Council.
- Ross, J., J. Stover, and D. Adelaja. 2005. *Profiles for Family Planning and Reproductive Health Programs: 116 Countries*. 2nd edition. Glastonbury, Connecticut, USA: The Futures Group.
- Rustein, S. 2002. *Fertility Levels, Trends and Differentials: 1995-1999*. Demographic and Health Survey Comparative Reports No. 3. Calverton, Maryland, USA: Macro International, Inc.

- Schoumaker, B. 2009. "Stalls in Fertility Transitions in Sub-Saharan Africa: Real or Spurious?" Université Catholique de Louvain (Belgium), Département des Sciences de la Population et du Développement, Document de Travail No 30 (DT-SPED-30).
- Shapiro, D. 2011. "Women's Education and Fertility Transition in Sub-Saharan Africa." Paper presented at IIASA, Wittgenstein Centre Conference on Education and the Global Fertility Transition, Vienna, Austria, November 30–December 1.
- Shapiro, D., and T. Gebreselassie. 2008. "Fertility Transition in Sub-Saharan Africa: Falling and Stalling." *African Population Studies* 23: 3-23.
- Smith, P.C. 1983. "The Impact of Age at Marriage and Proportions Marrying on Fertility." In *Determinants of Fertility in Developing Countries: Fertility Regulation and Institutional Influences*, edited by R.A. Bulatao and R.D. Lee, New York, New York, USA: Academic Press.
- Sneeringer, S.E. 2009. *Fertility Transition in Sub-Saharan Africa: A Comparative Analysis of Cohort Trends in 30 Countries*. DHS Comparative Reports No. 23. Calverton, Maryland, USA: ICF Macro.
- Solo, J. 2008. *Family Planning in Rwanda: How a Taboo Topic became Priority Number One*. Chapel Hill, North Carolina, USA: IntraHealth International.
- Udjo, E.O. 2001. "Marital Patterns and Fertility in South Africa: The Evidence from the 1996 Population Census." XXIV International Union for the Scientific Study of Population General Conference, Salvador, Brazil, August 18 – 24.
- United Nations. 1995. *Women's Education and Fertility Behavior: Recent Evidence from the Demographic and Health Surveys*. New York, New York, USA: United Nations.
- United Nations. 2007. *Completing the Fertility Transition*. New York, New York, USA: United Nations, Population Division.
- United Nations, Department of Economic and Social Affairs, and Population Division. 2013. *World Population Prospects: The 2012 Revision*, CD-ROM Edition.
- van de Walle, E. 1968. "Marriage in African Censuses and Inquiries." In *The Demography of Tropical Africa*, edited: W. Brass, page 183-238, Princeton, New Jersey, USA: Princeton University Press.
- van de Walle, E. 1993. "Recent Trends in Marriage Ages." In *Demographic Change in Sub-Saharan Africa*, edited by K.A. Foote, K.H. Hill, and L.G. Martin, page 117-152, Washington D.C., USA: National Academy Press.
- Wawire, S., and A.M. Jensen. 2013. "Come We Stay: Changes in Family, Marriage and Fertility in Western and Coastal Kenya." IUSSP Conference, Busan, Korea, August 2013.
- Westoff, C.F., A.K. Blanc, and L. Nyblade. 1994. *Marriage and Entry into Parenthood*. DHS Comparative Studies No 10. Columbia, IRD-Macro.
- Westoff, C.F., D.A. Koffman, and C. Moreau. 2011. *The Impact of Television and Radio on Reproductive Behavior and on HIV/AIDS Knowledge and Behavior*. DHS Analytical Studies No. 24. Calverton, Maryland, USA: ICF International.

Winship, C., and S.L. Morgan. 1999. "The Estimation of Causal Effects from Observational Data."
Annual Review of Sociology 25: 659-706.

Appendix A: Surveys Included in the Study

Table A-1. List of DHS and related surveys included in the study

| Country | WFS | DHS-I | DHS-II | DHS-III | DHS-IV | DHS-V | DHS-VI |
|----------------------|------|-------|--------|---------|--------|-------|--------|
| Benin | 1982 | | | 1996 | 2001 | 2006 | |
| Burkina Faso | | | 1993 | 1999 | 2003 | | 2010 |
| Burundi | | 1987 | | | | | 2010 |
| Cameroon | 1978 | 1991 | | 1998 | 2004 | | 2011 |
| Central African Rep. | | | | 1994 | | | |
| Chad | | | | 1997 | 2004 | | |
| Congo-Brazzaville | | | | | | 2005 | |
| Congo-Kinshasa | | | | | | 2007 | 2009 |
| Côte d'Ivoire | 1980 | | | 1994 | 1999 | 2005 | |
| Ethiopia | | | | | 2000 | 2005 | 2011 |
| Gabon | | | | | 2000 | | 2012 |
| Ghana | 1979 | 1988 | 1993 | 1999 | 2003 | 2008 | |
| Guinea | | | | 1999 | | 2005 | |
| Kenya | 1978 | 1988 | 1993 | 1998 | 2003 | 2008 | |
| Lesotho | 1977 | | | | 2004 | 2009 | |
| Liberia | | 1986 | | | | 2007 | |
| Madagascar | | | 1992 | 1997 | 2003 | 2008 | |
| Malawi | | | 1992 | 1996 | 2000 | 2004 | 2010 |
| Mali | | 1987 | | 1995 | 2001 | 2006 | |
| Mozambique | | | | 1997 | | 2003 | 2011 |
| Namibia | | | 1992 | | 2000 | 2007 | |
| Niger | | | 1992 | 1998 | | 2006 | |
| Nigeria | 1982 | 1990 | | 1999 | 2003 | 2008 | |
| Rwanda | 1983 | | 1992 | | 2000 | 2005 | 2011 |
| Senegal | 1978 | 1986 | 1993 | 1997 | | 2005 | 2011 |
| Sierra Leone | | | | | | 2008 | |
| South Africa | | | | 1998 | | | |
| Swaziland | | | | | | 2006 | |
| Tanzania | | | 1991 | 1996 | 1999 | 2004 | 2010 |
| Togo | | 1988 | | 1998 | | | |
| Uganda | | 1988 | | 1995 | 2001 | 2006 | 2011 |
| Zambia | | | 1992 | 1996 | 2001 | 2007 | |
| Zimbabwe | | 1988 | | 1994 | 1999 | 2005 | 2010 |

Appendix B: Country Studies

This appendix details, country by country, the results of the procedures for fitting trends in age at marriage, their relationship with trends in level of education, and the data on age and cohort effects on contraceptive use. Selection of data and methods used for the calculations are presented in Chapter 3 of the report.

Presentation of the Country Studies

The country studies are all presented on the same model. Each country section presents the data used, with a table containing some basic statistics: the number of women interviewed, the estimate of period median age at marriage (as published in DHS reports), the estimate of period ever-use of contraception among women age 15-49 (recalculated), and the estimate of period level of education, measured by the mean number of years schooling among women age 20-49 (recalculated).

Three figures are then presented, each with a brief comment. The first figure presents trends in cohort median age at first marriage, for urban and rural areas separately, with the fitted trend in solid lines and the observed values in five-year cohorts as dots. The reading of this figure is straightforward.

The second figure presents the path followed by the relationship between cohort level of education (X-axis) and cohort age at first marriage (Y-axis), each dot representing a yearly cohort. The reading of this figure is more complex, since trends appear in the path, not on the X-axis. The main objective of these figures is to show the complexity of the relationship in a longitudinal perspective, which is far more complex than the classic linear relationship found in the cross-sectional studies.

The third figure presents the age and cohort effects of ever-use of modern contraception. This figure aims at displaying the linearity of the age and cohort effects. The dots are the surveys conducted in the country. The lines display the cohort effects (X-axis). The age effects can be deduced by comparing dots on vertical lines (for the same cohorts). Two situations may occur. In case of several surveys in the same country, the cohort effects appear as the slopes of each line. Cohort trends are usually monotonic and parallel for each age group, except for age 15-19. In case of a single survey in a country, the pattern presented by the age groups is always a bell-shaped (e.g. inverted U-shape) pattern, the first part (increasing) describing the cohort effect, the second part (decreasing) describing the age effect.

Providing a full explanation for all patterns displayed in the following figures is beyond the scope of this study. Readers are encouraged to go back to the original data and to analyze the country data further.

1. Benin

Four surveys were available in Benin: three DHS surveys conducted in 1996, 2001, and 2006, plus a WFS survey conducted in 1982. They were compatible for age at marriage, level of education, and ever-use of contraception.

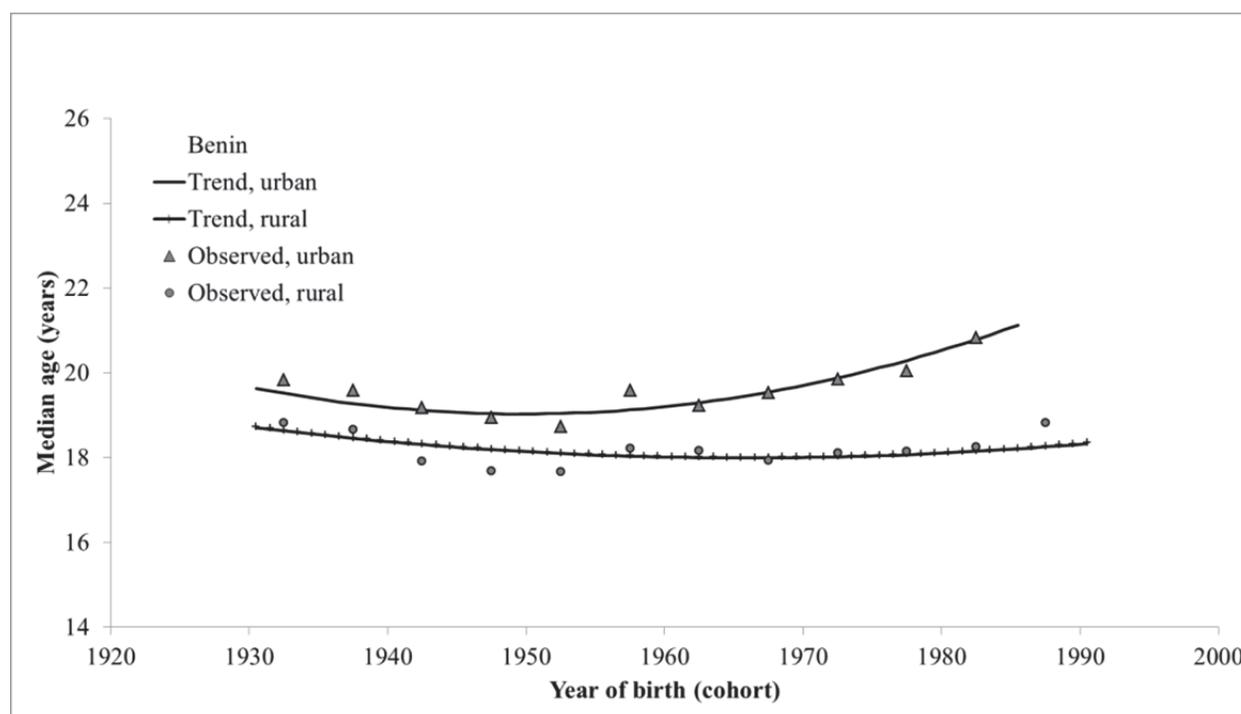
Table B-1.1. Survey characteristics, Benin

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1982 | 4,018 | 18.3 | 1.14 | 3.0 |
| DHS | 1996 | 5,416 | 18.4 | 1.53 | 11.7 |
| DHS | 2001 | 6,277 | 18.8 | 2.09 | 21.6 |
| DHS | 2006 | 18,455 | 18.6 | 2.31 | 22.1 |

Trends in age at marriage (Figure B-1.1)

Median age at first marriage was average in Benin for cohorts born in the 1930s, with a small difference between urban and rural areas, and a small declining trend. It increased in urban areas for cohorts born after 1960, while remaining roughly constant in rural areas.

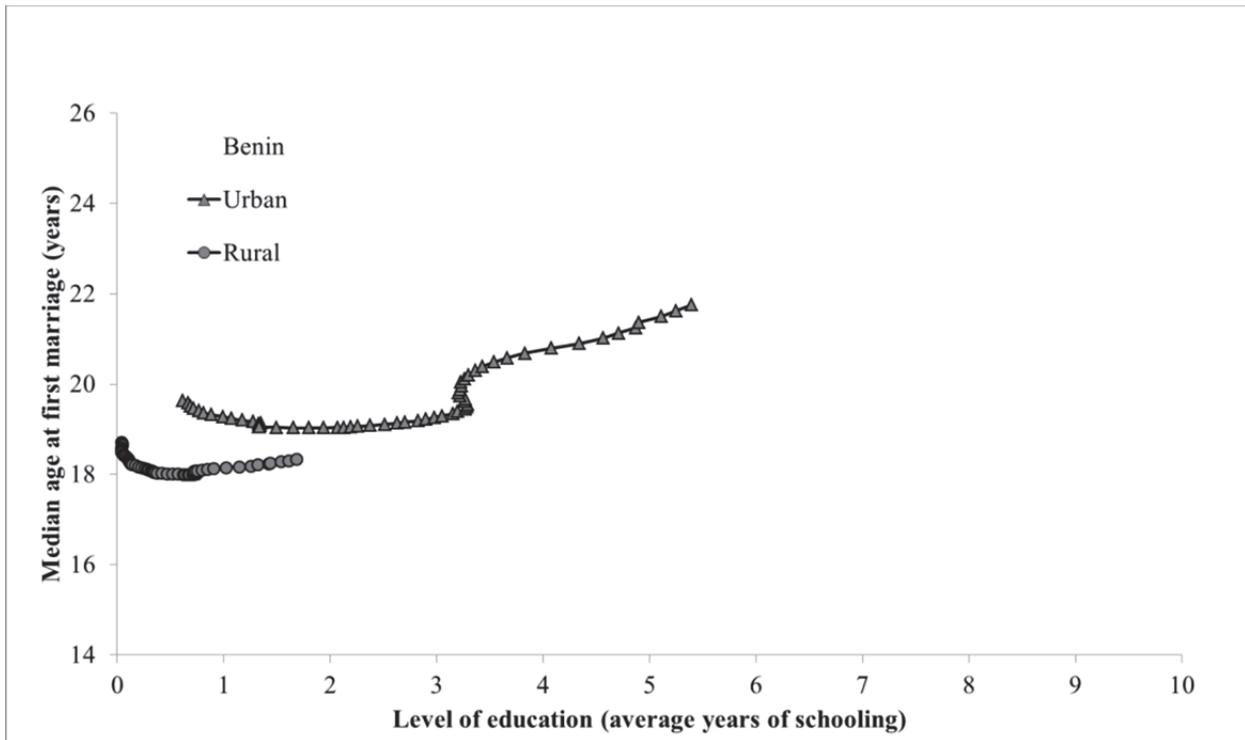
Figure B-1.1. Reconstructed trends in median age at first marriage, Benin



Relationship with education (Figure B-1.2)

The relationship between trends in level of education and in age at marriage was not linear. The change in trends in urban areas was due to a decline in level of education for cohorts 1965-1975 while age at marriage continued to increase.

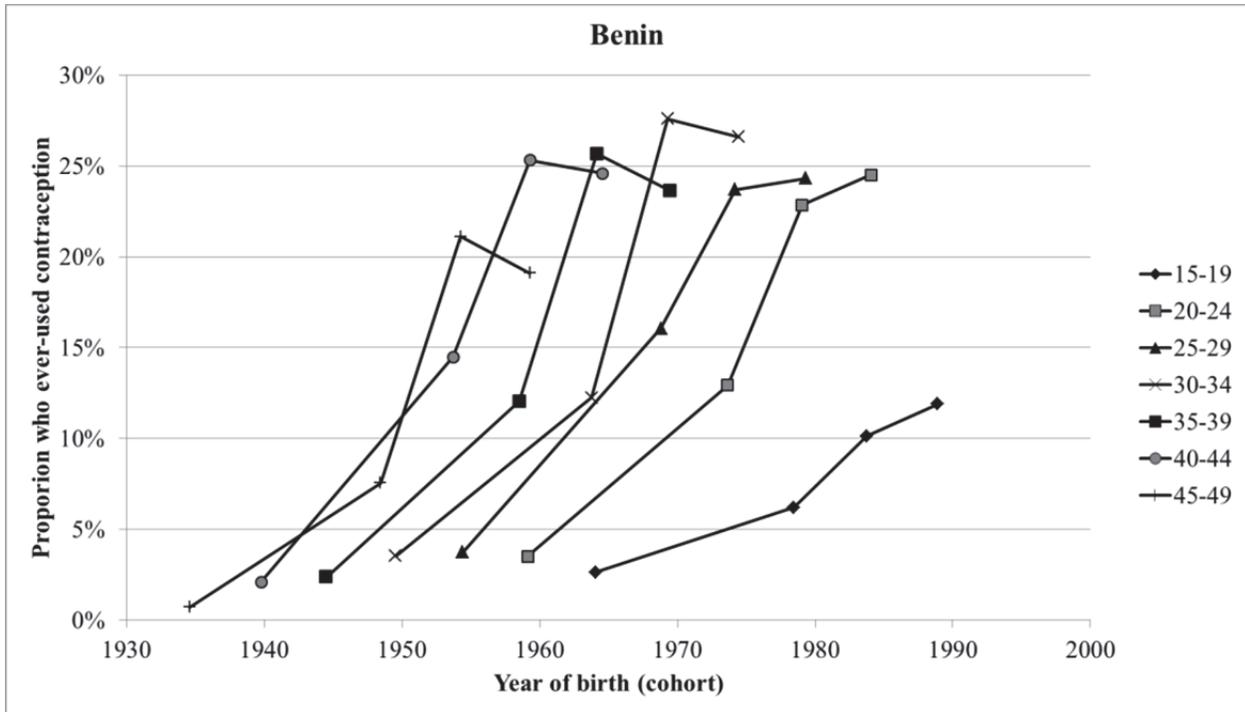
Figure B-1.2. Relationship between level of education and age at first marriage, Benin



Trends in contraceptive use (Figure B-1.3)

Contraceptive use increased steadily for cohorts born before the 2006 survey. However, in the 2006 survey the proportion of women who ever-used contraception stagnated for women age 30-49, meaning that there were few new acceptors between 2001 and 2006. This was not true for younger women age 15-29.

Figure B-1.3. Cohort trends in age-specific ever-use of contraception, Benin



2. Burkina Faso

Four surveys were available in Burkina Faso, conducted in 1993, 1999, 2003, and 2010. The 2010 survey did not have information on ever-use of contraception. Otherwise, the surveys were compatible with respect to the three variables, with a minor discrepancy for the mean level of education between the 1993 and the 1999 surveys.

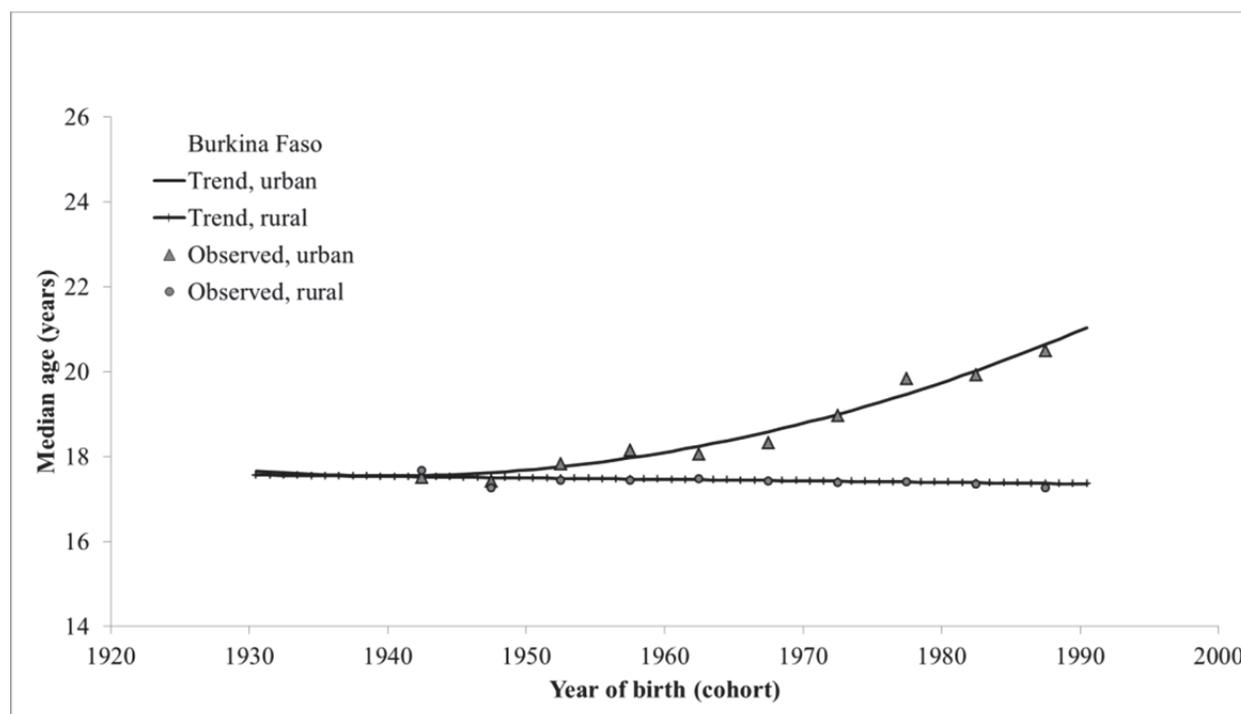
Table B-2.1. Survey characteristics, Burkina Faso

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1993 | 6,354 | 17.5 | 1.09 | 9.9 |
| DHS | 1999 | 6,445 | 17.6 | 0.93 | 13.1 |
| DHS | 2003 | 12,477 | 17.7 | 1.38 | 20.4 |
| DHS | 2010 | 17,087 | 17.8 | 1.77 | |

Trends in age at marriage (Figure B-2.1)

Median age at first marriage was average in Burkina Faso for cohorts born in the 1930s, with no difference between urban and rural areas. Age at marriage increased markedly in urban areas for cohorts born after 1960, while remaining roughly constant in rural areas.

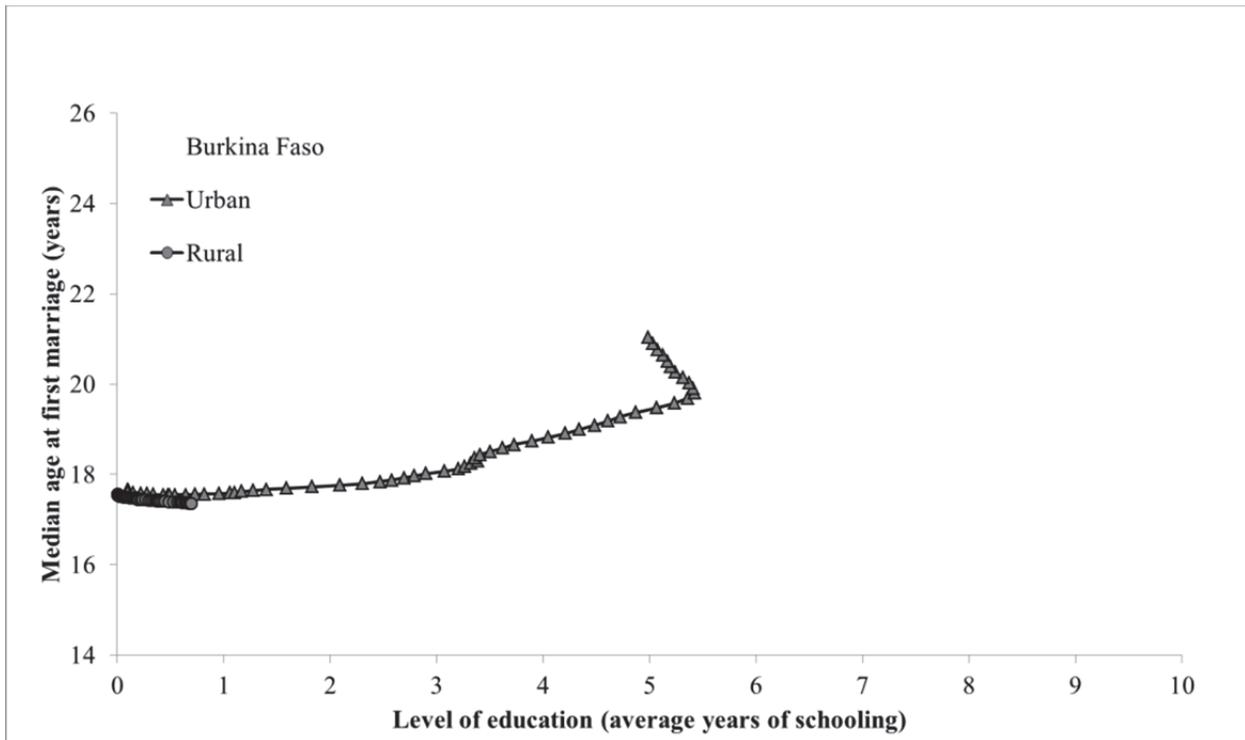
Figure B-2.1. Reconstructed trends in median age at first marriage, Burkina Faso



Relationship with education (Figure B-2.2)

Relationship with education was hardly existent in rural areas because of the low level of education, and complex in urban areas, where age at marriage continued to increase while level of education was declining.

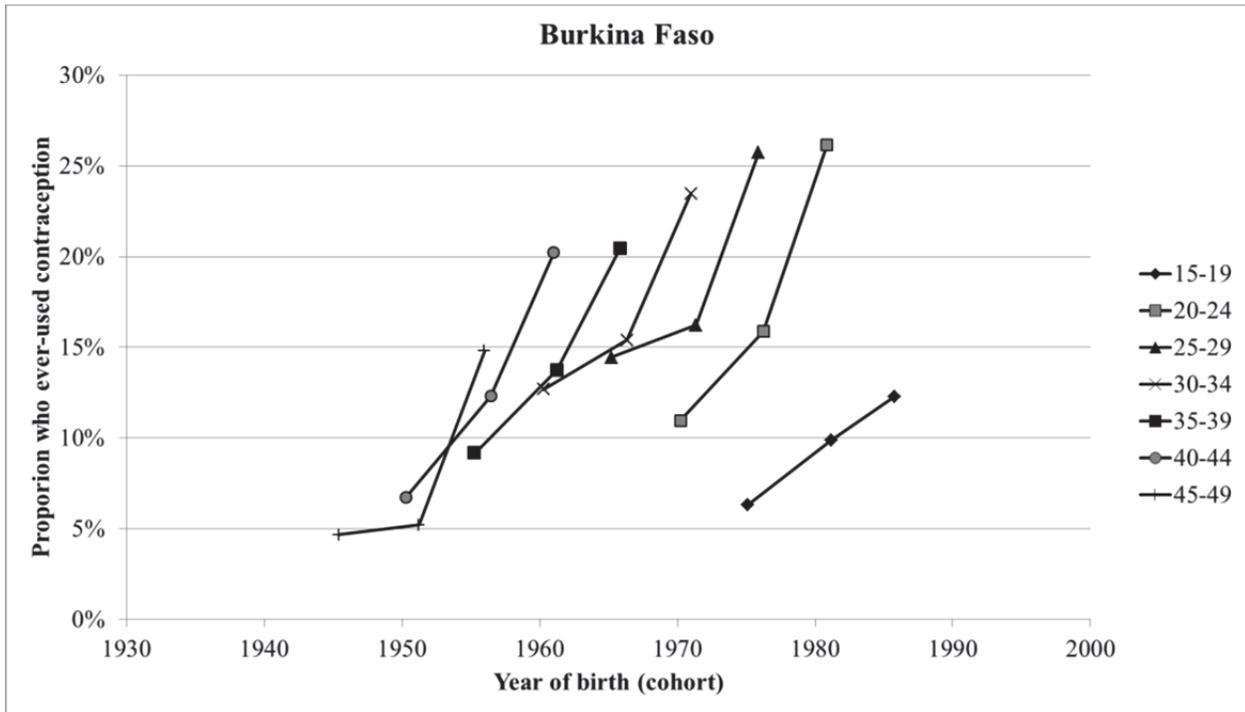
Figure B-2.2. Relationship between level of education and age at first marriage, Burkina Faso



Trends in contraceptive use (Figure B-2.3)

Trends in cohort use of contraception were regular, and very marked (strong slope) for cohorts born after 1950, however with a rather low level (< 30%).

Figure B-2.3. Trends in age-specific ever-use of contraception, Burkina Faso



3. Burundi

Two surveys were available in Burundi, conducted in 1987 and 2010. The 2010 survey did not provide information on ever-use of contraception.

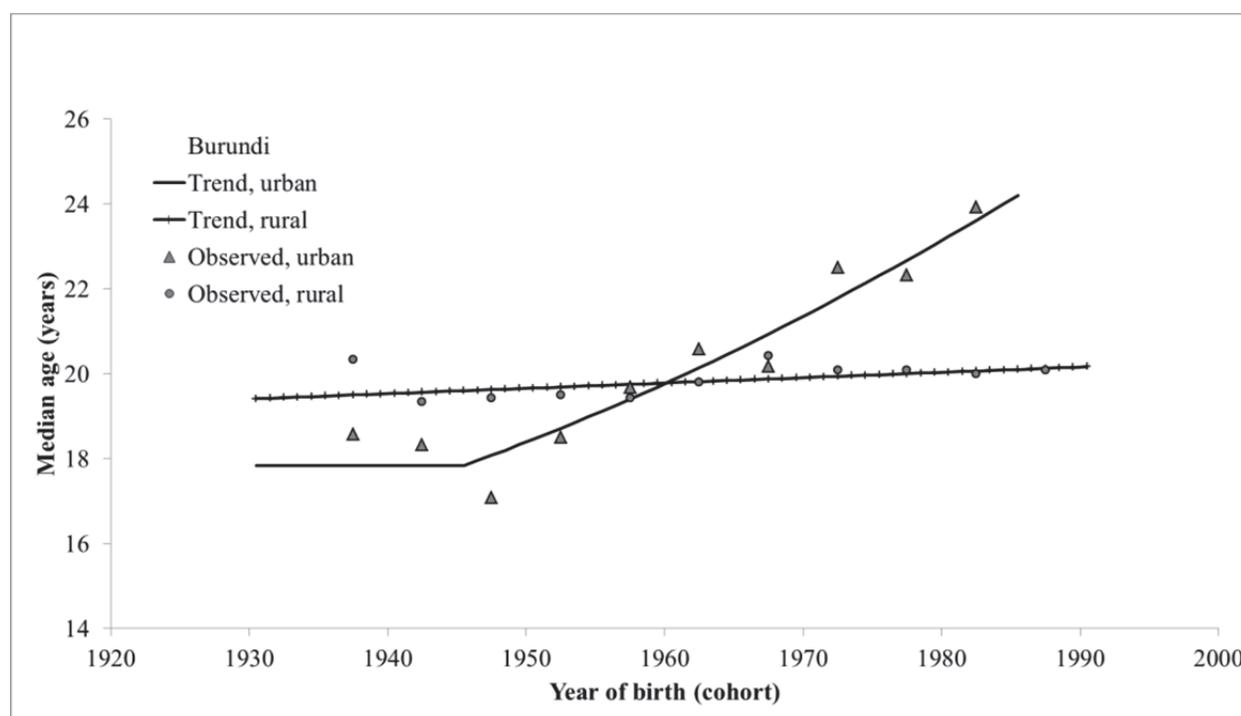
Table B-3.1. Survey characteristics, Burundi

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1987 | 3,970 | 19.5 | 0.89 | 1.9 |
| DHS | 2010 | 9,389 | 20.3 | 3.07 | |

Trends in age at marriage (Figure B-3.1)

Median age at first marriage was rather high in Burundi by African standards (as in nearby Rwanda), and appeared somewhat lower in urban areas than in rural areas for cohorts born before 1960. Age at marriage increased markedly in urban areas since cohort 1950, and reached relatively high values for the cohorts born after 1980, while it remained approximately constant in rural areas.

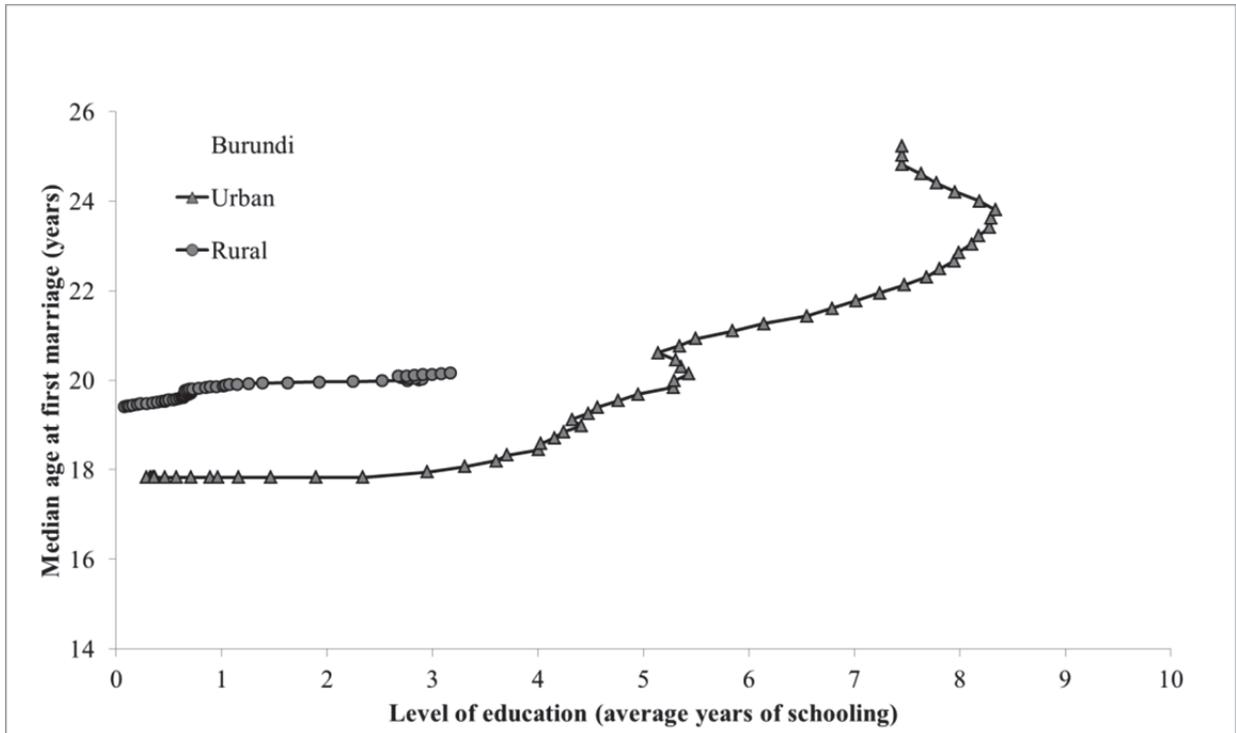
Figure B-3.1. Reconstructed trends in median age at first marriage, Burundi



Relationship with education (Figure B-3.2)

The relationship between trends in level of education and in age at marriage was straightforward in rural areas, but not linear in urban areas. The change in trends in urban areas was due to a decline in level of education, a first time for cohorts 1962-1964, and a second time for cohorts 1983-1990, while age at marriage continued to increase.

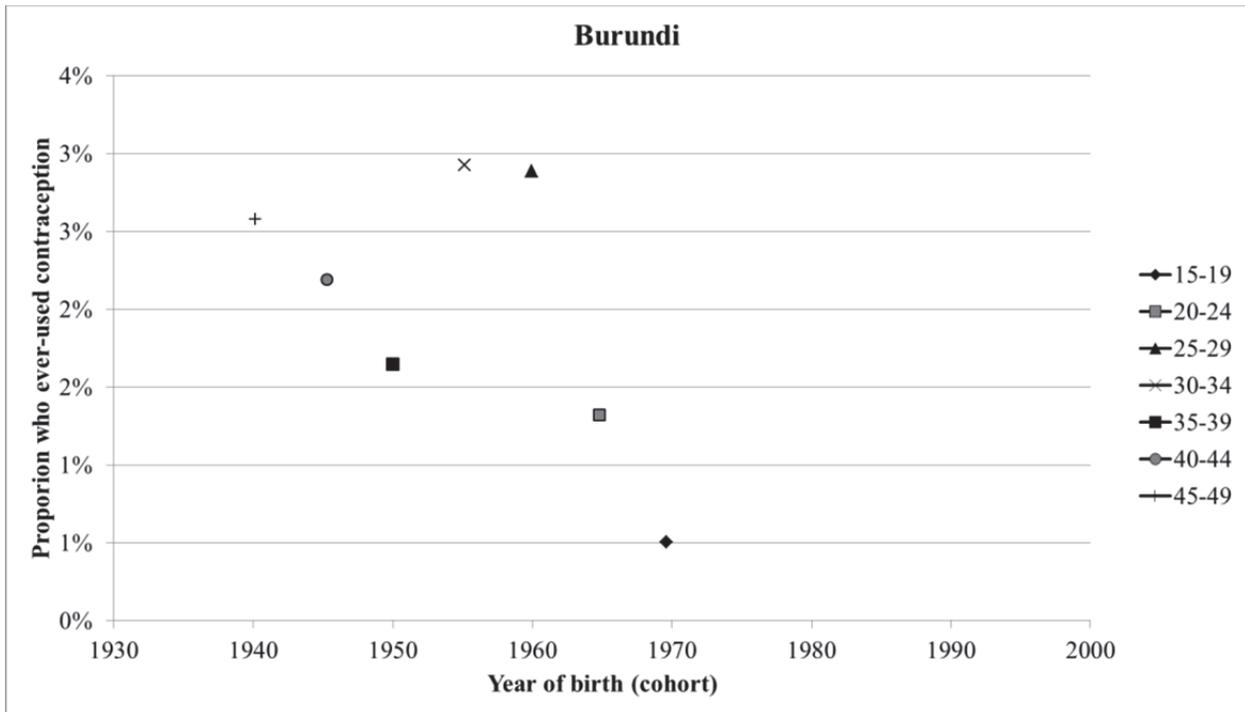
Figure B-3.2. Relationship between level of education and age at first marriage, Burundi



Trends in contraceptive use (Figure B-3.3)

Knowledge of trends in contraceptive use is limited in Burundi, because of a lack of data since the 1987 survey. If the age effect is clearly visible for the 15-34 age group, the cohort effect is not as expected for women age 35-49. This case requires further research.

Figure B-3.3. Trends in age-specific ever-use of contraception, Burundi



4. Cameroon

Four DHS surveys and one WFS survey were available for Cameroon. The 2011 survey had no information on ever-use of contraception. The surveys were compatible for all three variables considered.

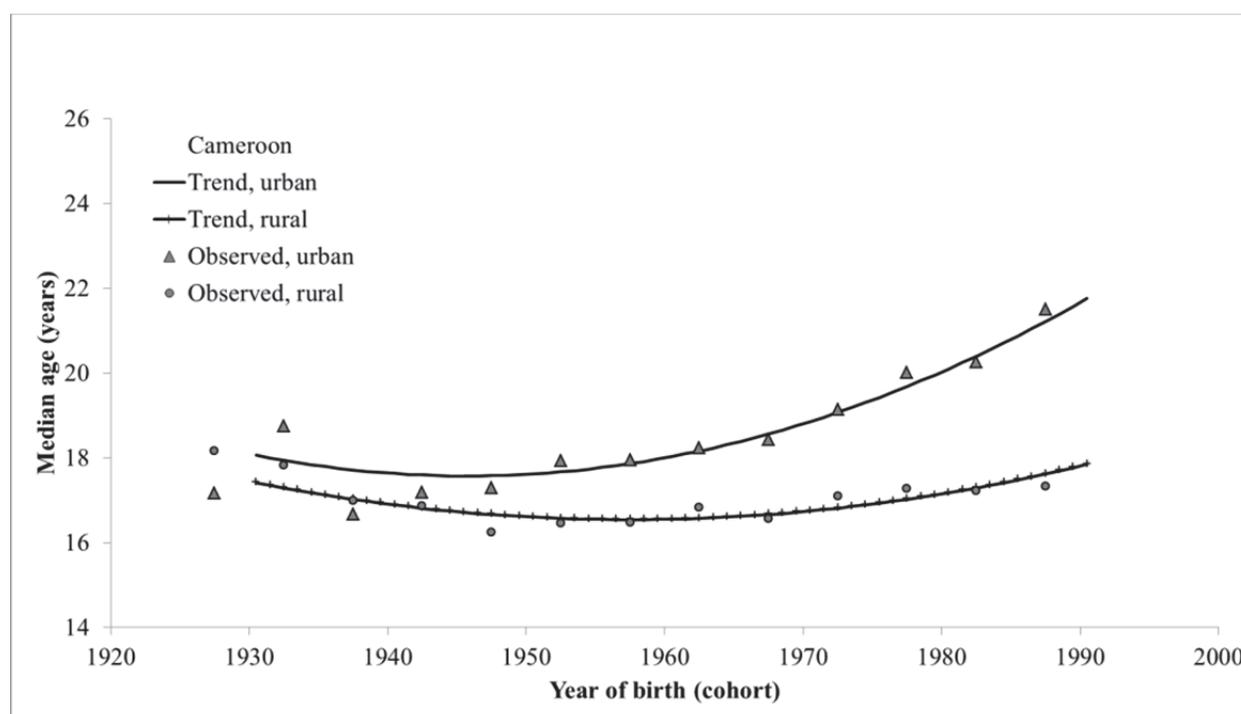
Table B-4.1. Survey characteristics, Cameroon

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1978 | 8,219 | 17.0 | 2.12 | 2.6 |
| DHS | 1991 | 3,871 | 16.5 | 3.97 | 15.7 |
| DHS | 1998 | 5,501 | 17.4 | 5.30 | 29.5 |
| DHS | 2004 | 10,656 | 17.6 | 5.62 | 38.1 |
| DHS | 2011 | 15,426 | 18.5 | 6.20 | |

Trends in age at marriage (Figure B-4.1)

Median age at first marriage was average in Cameroon for cohorts born before 1950, with a small difference between urban and rural areas, and a small declining trend. It increased markedly in urban areas for cohorts born after 1960, and increased only marginally in rural areas.

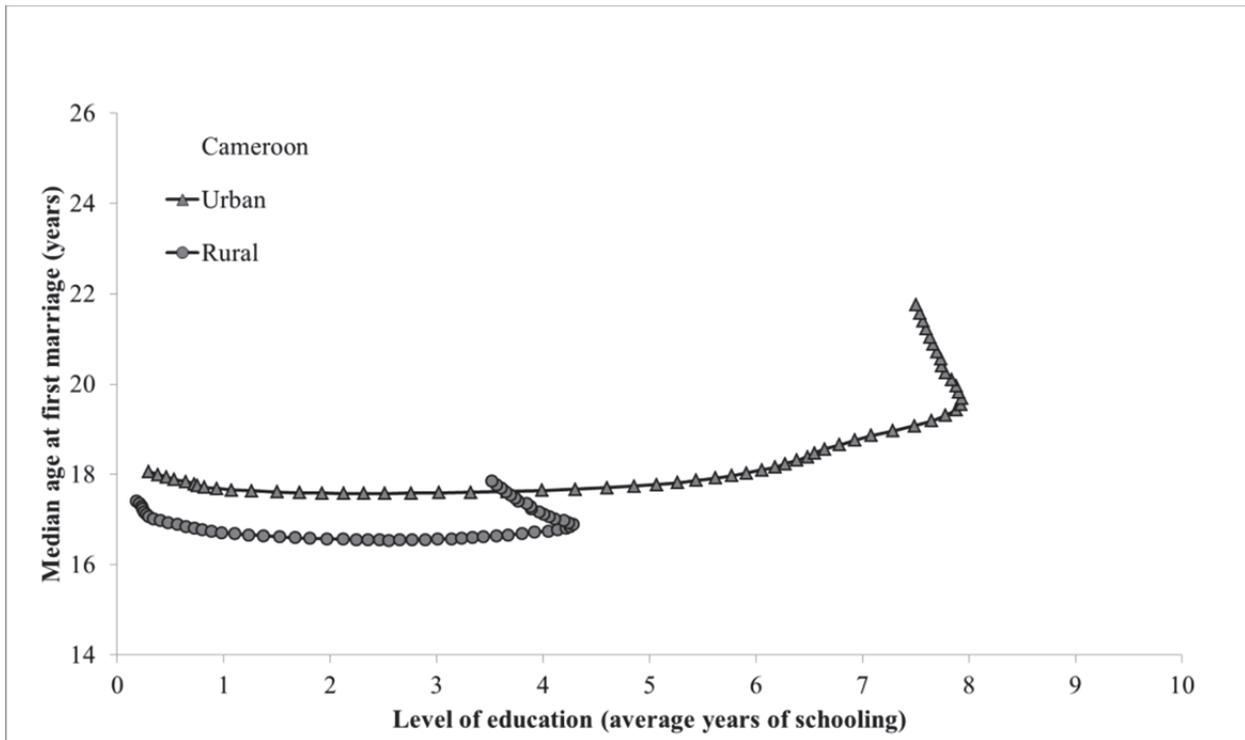
Figure B-4.1. Reconstructed trends in median age at first marriage, Cameroon



Relationship with education (Figure B-4.2)

The relationship between trends in level of education and in age at marriage was not linear, in both urban and rural areas. The change in trends was due to a decline in level of education for cohorts 1970-1980 in urban areas, and for cohorts 1975-1980 in rural areas, while age at marriage continued to increase.

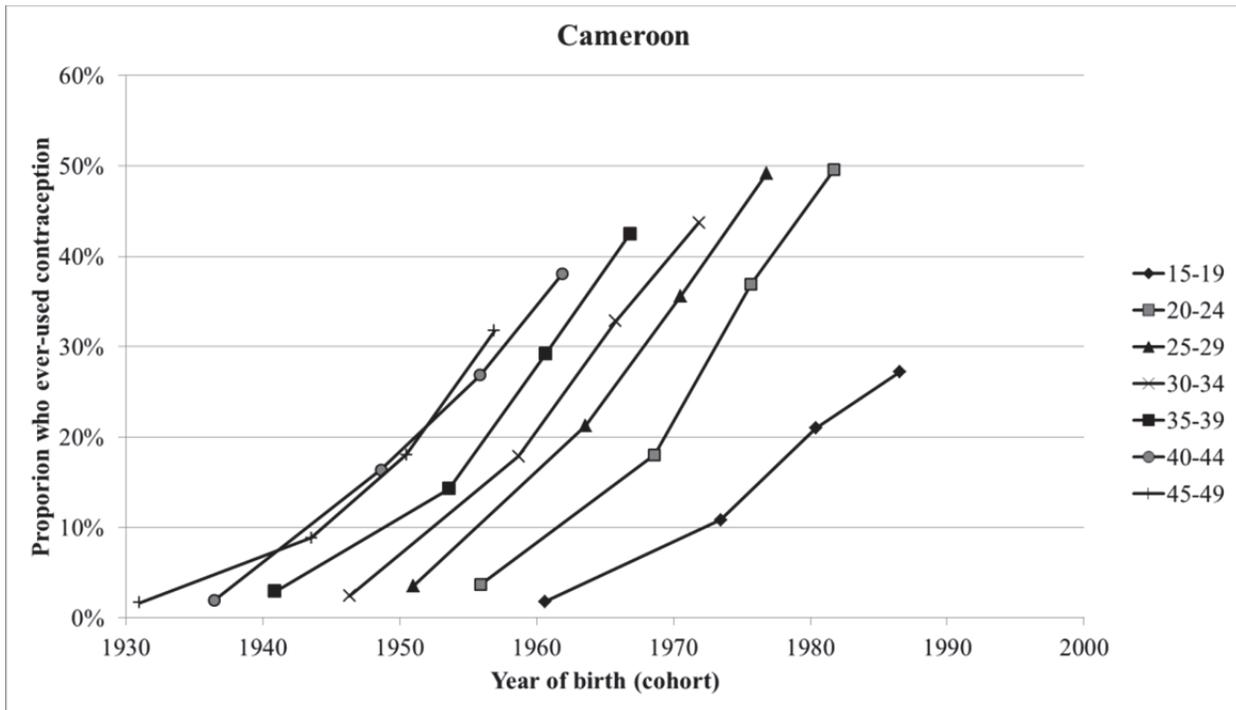
Figure B-4.2. Relationship between level of education and age at first marriage, Cameroon



Trends in contraceptive use (Figure B-4.3)

Ever-use of contraception increased steadily for all cohorts considered, starting from virtually no contraception for the oldest cohorts (1930s) to relatively high levels (above 50%) for cohorts born in the 1970s. Even the younger age group (15-19) now has a relatively high level of contraceptive use.

Figure B-4.3. Trends in age-specific ever-use of contraception, Cameroon



5. Central African Republic

Only one survey (1994) was available in the Central African Republic, which seriously limits the trend analysis.

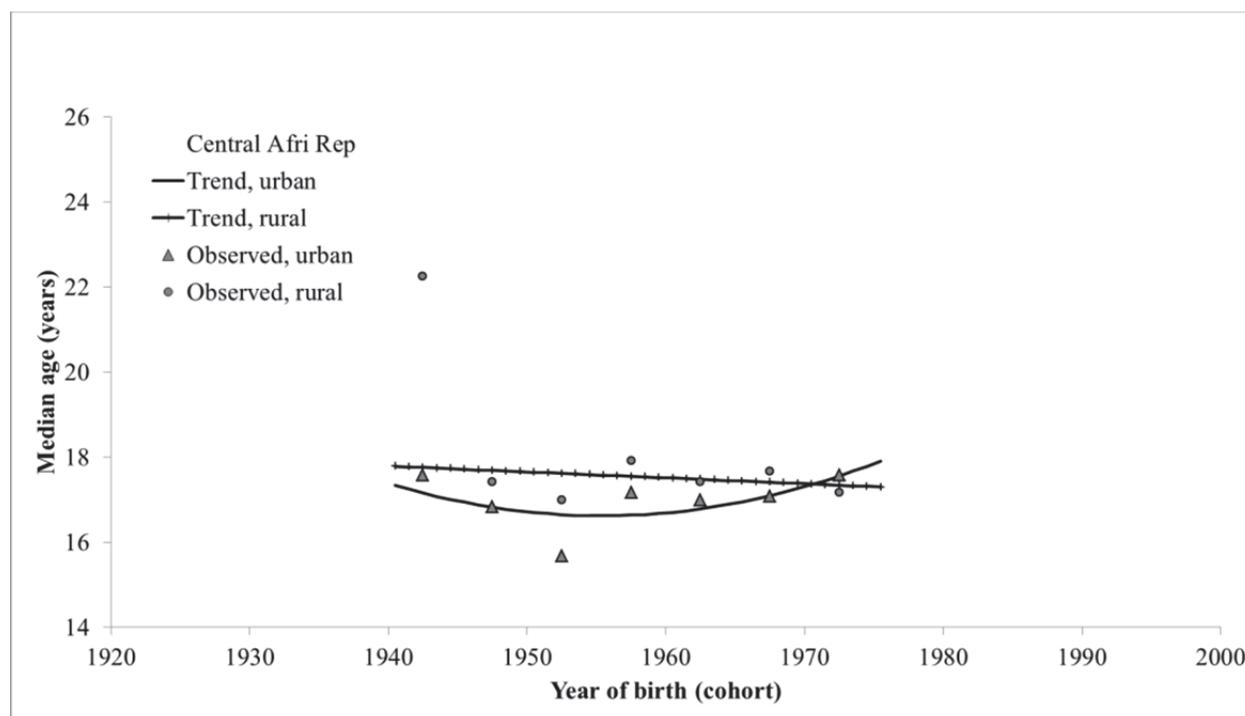
Table B-5.1. Survey characteristics, Central African Republic

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1994 | 5,884 | 17.3 | 2.18 | 12.2 |

Trends in age at marriage (Figure B-5.1)

Median age at first marriage was average in the Central African Republic, with a small difference between urban and rural areas, and virtually no trend. Only a very small increase could be noticed in the most recent cohort in urban areas,

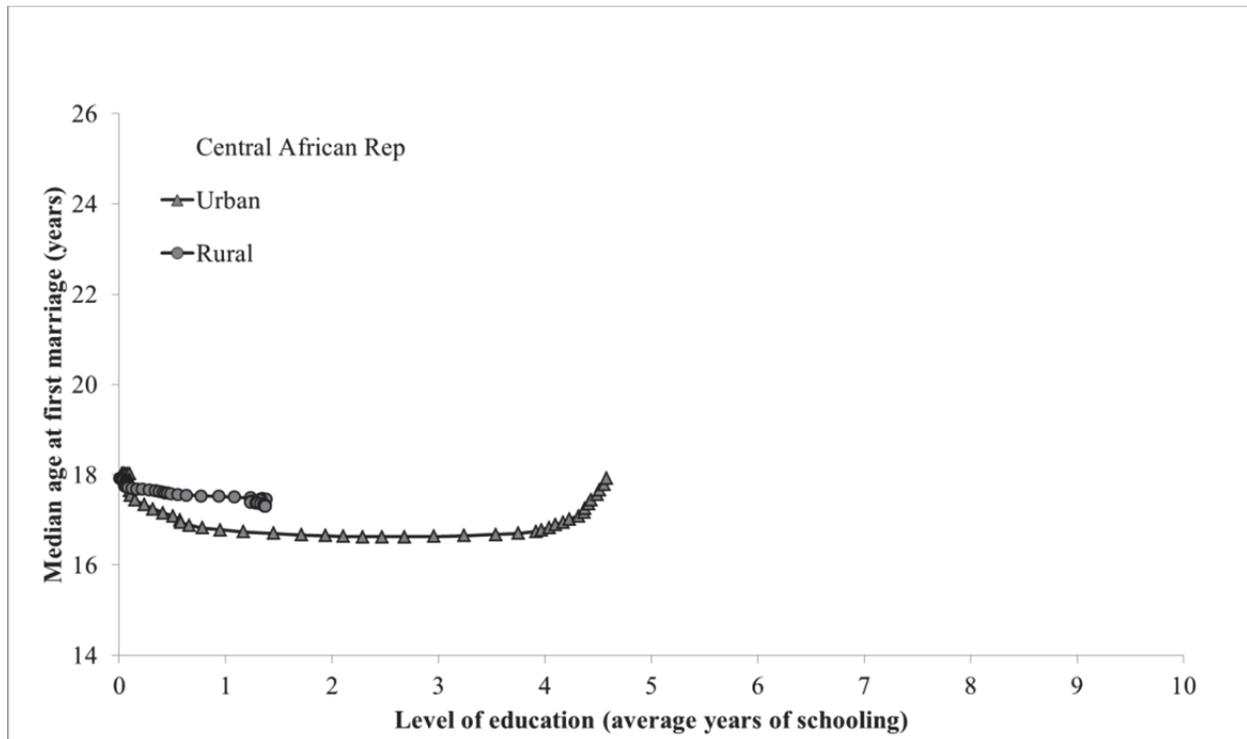
Figure B-5.1. Reconstructed trends in median age at first marriage, Central African Republic



Relationship with education (Figure B-5.2)

The relationship between age at marriage and level of education was not monotonic in urban areas. For the earlier cohorts, age at marriage tended to decline while level of education increased slightly. Then it stayed constant for a long time, to increase markedly for cohorts born between 1962 and 1975, despite only a minor increase in level of education. In rural areas, it stayed roughly constant, despite a minor increase in level of education.

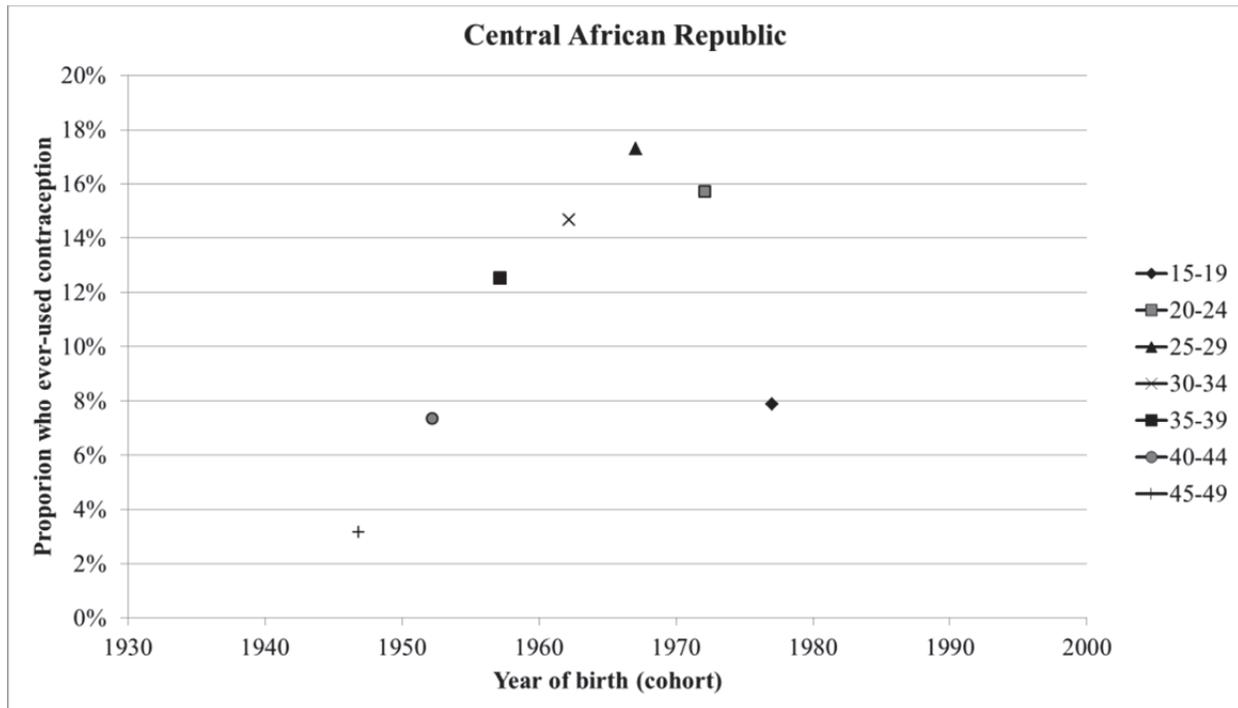
Figure B-5.2. Relationship between level of education and age at first marriage, Central African Republic



Trends in contraceptive use (Figure B-5.3)

Knowledge about ever-use of contraception is limited in the Central African Republic. However, one could notice a strong cohort effect by comparing the proportion of ever-use between the 25-29 and the 45-49 age groups, and a large age effect between the 15-19 and the 25-29 age groups, as expected.

Figure B-5.3. Trends in age-specific ever-use of contraception, Central African Republic



6. Chad

Two surveys were available in Chad, conducted in 1996 and 2004. Both were compatible with respect to the three variables considered. Note the low values for age at marriage, level of education, and ever-use of contraception.

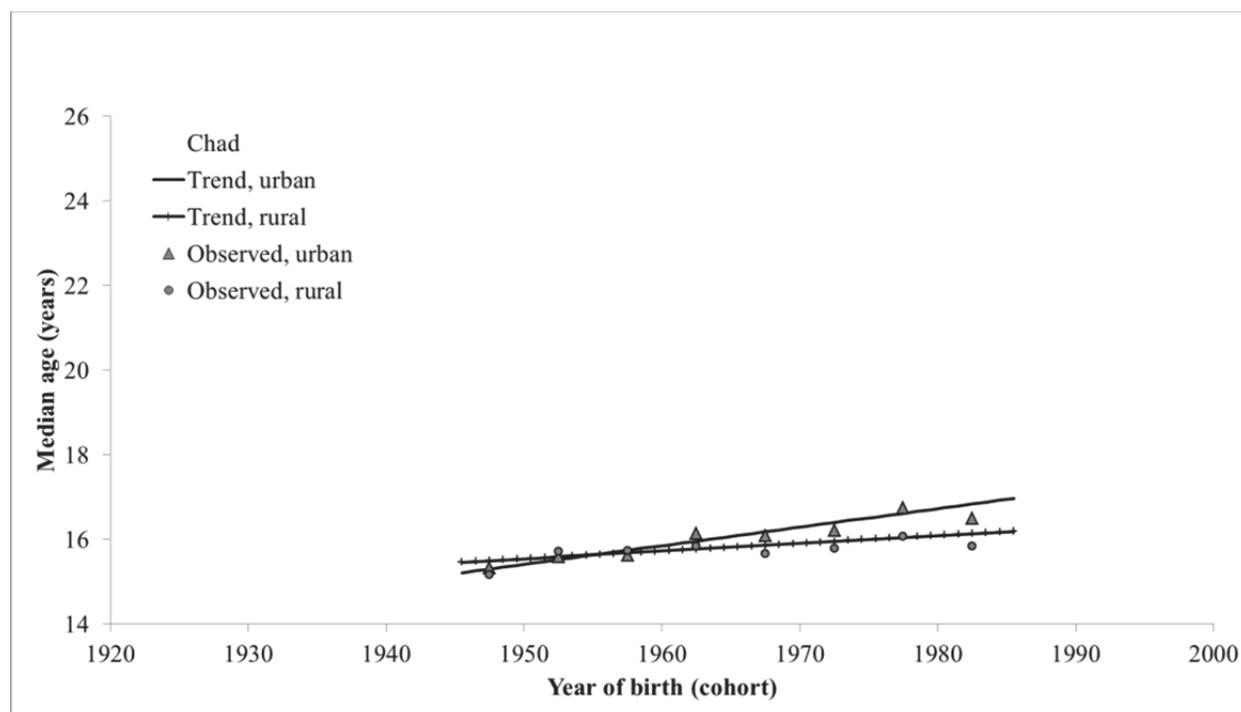
Table B-6.1. Survey characteristics, Chad

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1996 | 7,454 | 15.8 | 0.80 | 2.8 |
| DHS | 2004 | 6,085 | 15.9 | 1.21 | 4.8 |

Trends in age at marriage (Figure B-6.1)

Median age at first marriage was very low in Chad (as in nearby Niger), with a small slope in urban areas, and a tiny difference between urban and rural areas.

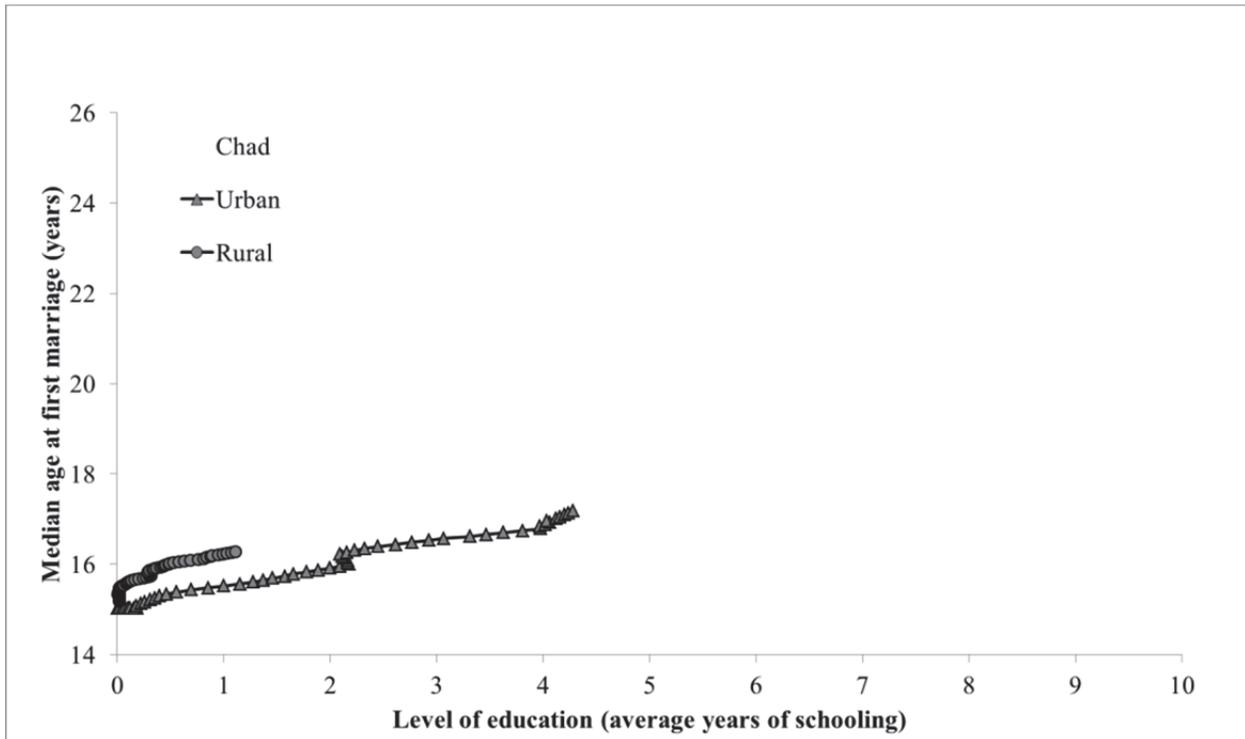
Figure B-6.1. Reconstructed trends in median age at first marriage, Chad



Relationship with education (Figure B-6.2)

The relationship between trends in level of education and in age at marriage was linear, as expected, but at low levels and with a low slope.

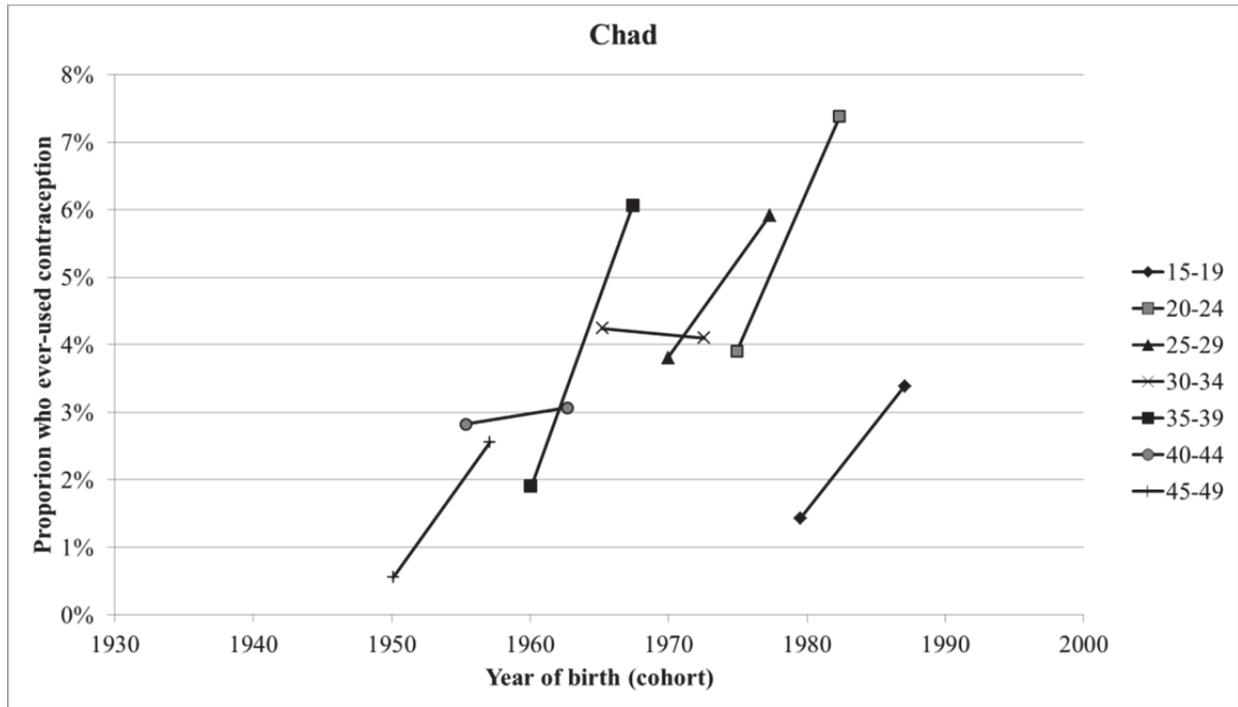
Figure B-6.2. Relationship between level of education and age at first marriage, Chad



Trends in contraceptive use (Figure B-6.3)

Contraceptive use had the expected age and cohort patterns, but remained at a low level (< 10% for any age group considered) and without significant differences for age 30-34.

Figure B-6.3. Trends in age-specific ever-use of contraception, Chad



7. Congo-Kinshasa (Democratic Republic of Congo)

Only one survey was available in Congo-Kinshasa, a country with low level of income despite relatively high level of education.

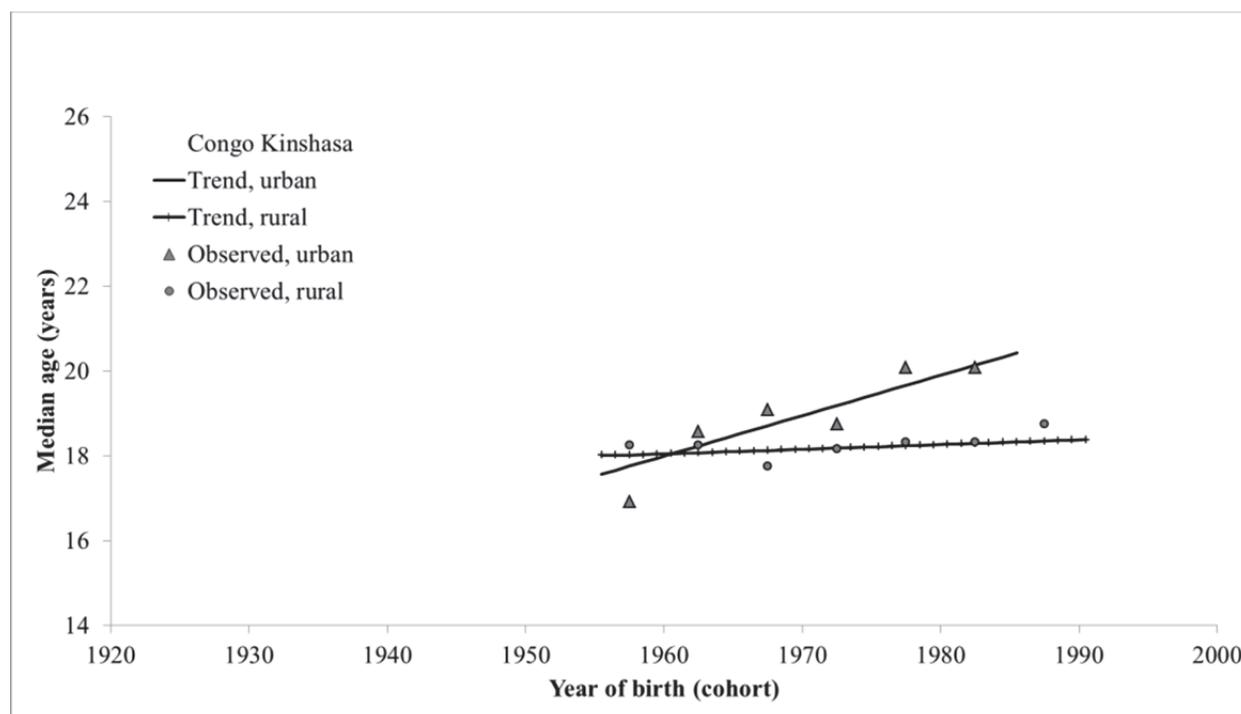
Table B-7.1. Survey characteristics, Congo-Kinshasa

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 2007 | 9,995 | 18.6 | 5.32 | 19.4 |

Trends in age at marriage (Figure B-7.1)

Median age at first marriage was average in Congo-Kinshasa for cohorts born before the 1960s, with no difference between urban and rural areas. Among the recent cohorts age at marriage increased in urban areas but increased only slightly in rural areas.

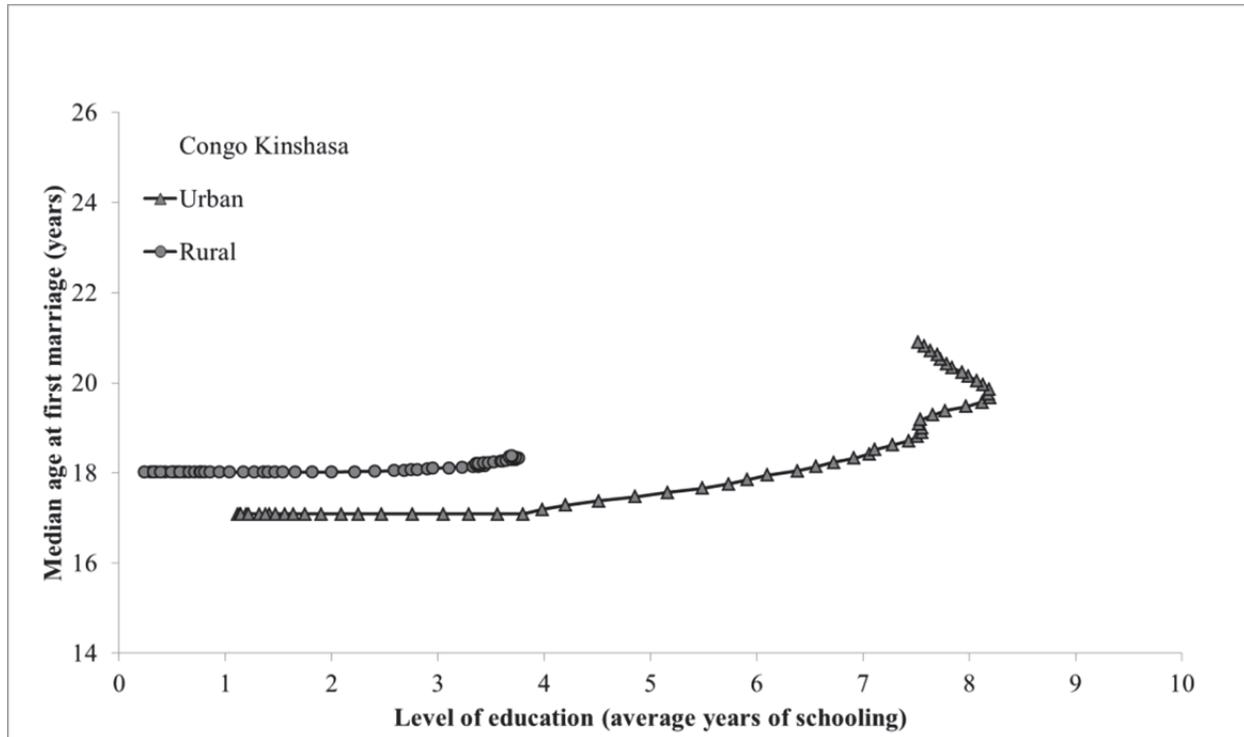
Figure B-7.1. Reconstructed trends in median age at first marriage, Congo-Kinshasa



Relationship with education (Figure B-7.2)

The relationship between trends in level of education and in age at marriage was not linear in urban areas. The change in trends in urban areas was due to a decline in level of education for cohorts 1970-1985, while age at marriage continued to increase. In rural areas, the increase in level of education had virtually no effect on age at marriage.

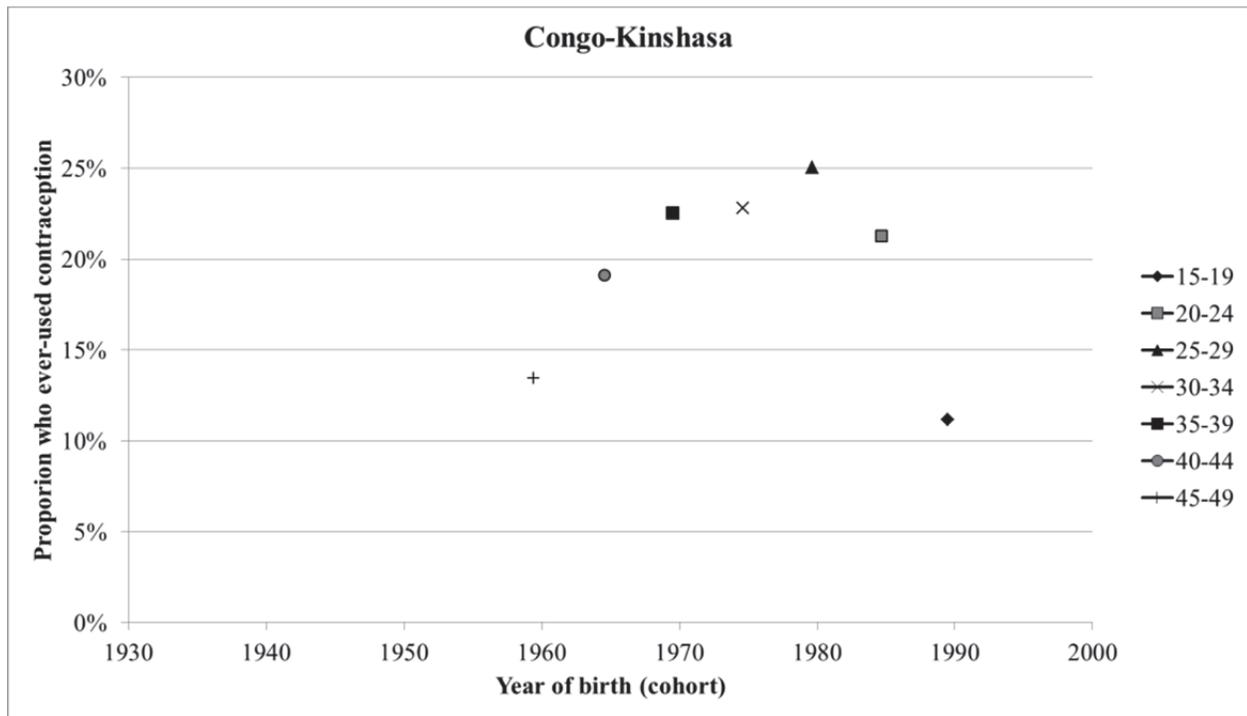
Figure B-7.2. Relationship between level of education and age at first marriage, Congo-Kinshasa



Trends in contraceptive use (Figure B-7.3)

The pattern of contraceptive use by age and cohort was as expected, with a strong cohort effect visible in the 25-29 to 45-49 age groups, and a strong age effect in the 15-19 to 25-29 age groups.

Figure B-7.3. Trends in age-specific ever-use of contraception, Congo-Kinshasa



8. Congo-Brazzaville (Republic of Congo)

Two surveys were available in Congo-Brazzaville (Republic of Congo). The second survey, an AIDS Indicator survey, had no information on contraceptive use.

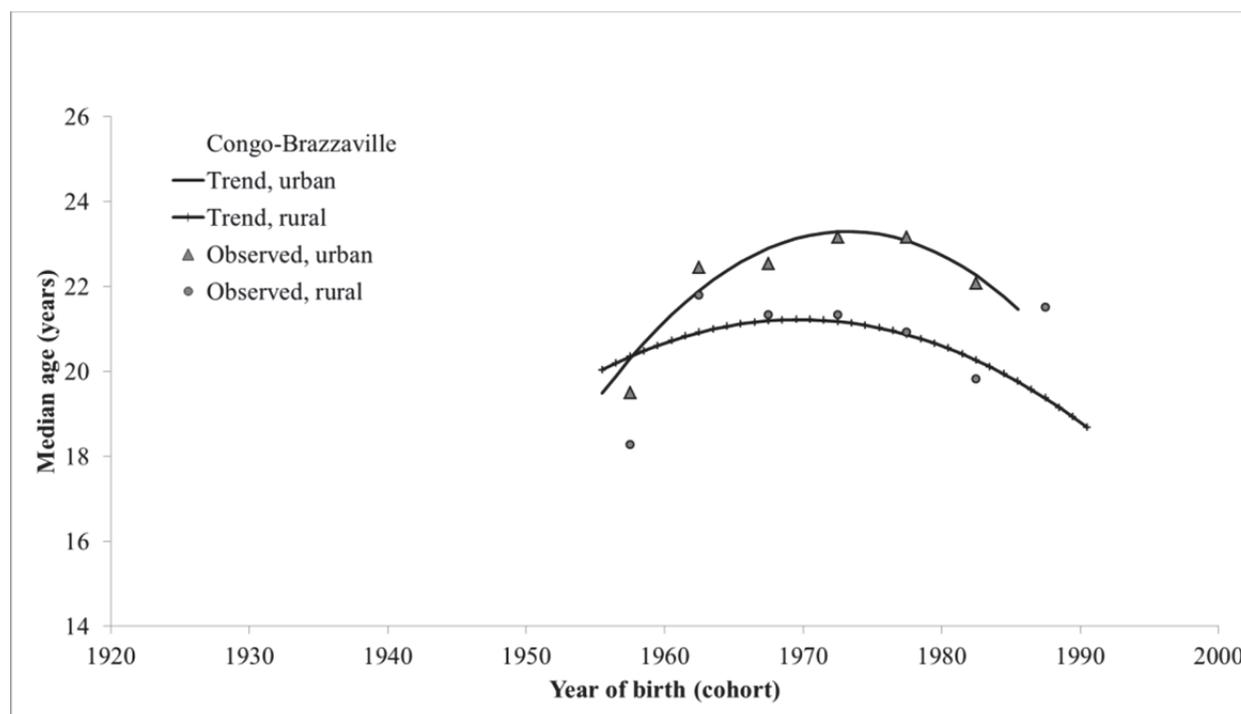
Table B-8.1. Survey characteristics, Congo-Brazzaville

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 2005 | 7,051 | 20.4 | 7.14 | 59.0 |
| AIS | 2009 | 12,413 | 20.2 | 7.95 | |

Trends in age at marriage (Figure B-8.1)

Median age at first marriage appeared to be relatively high in Congo-Brazzaville, with a unique pattern of ups (cohorts born before 1975) and downs (cohorts born after 1975). The changing pattern prevailed in both urban and rural areas, but was more marked in urban areas.

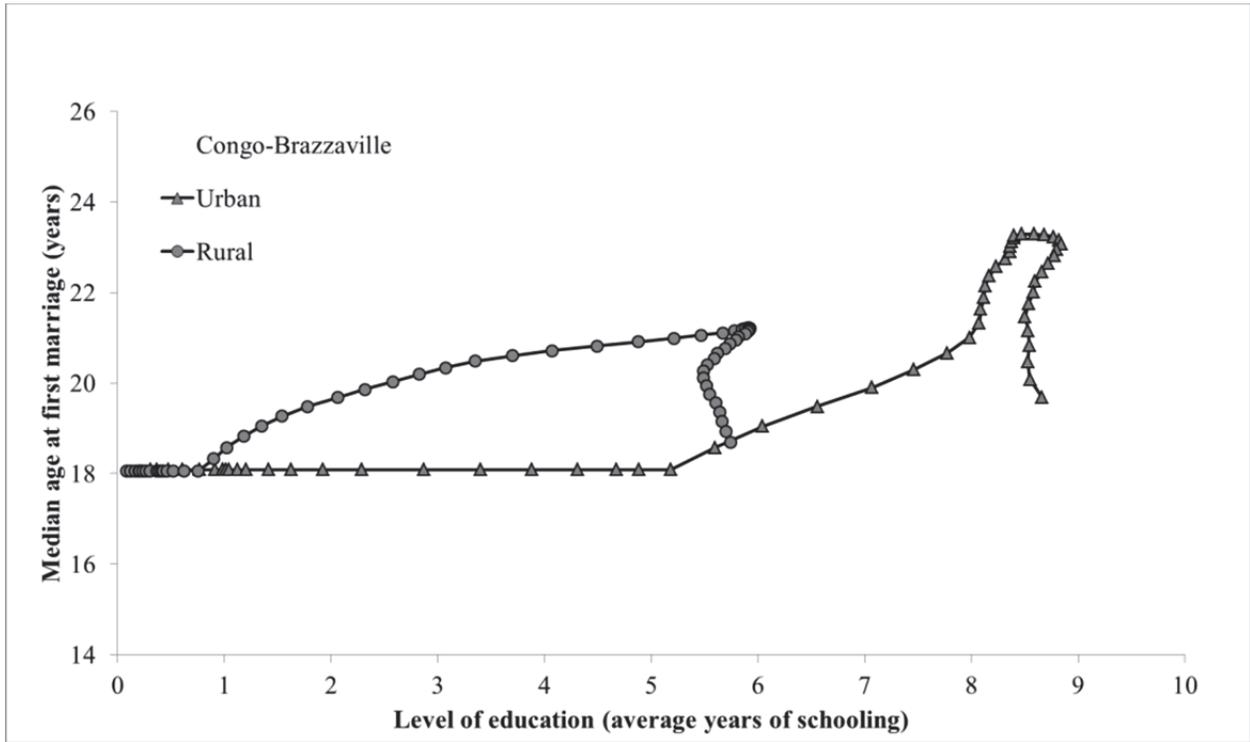
Figure B-8.1. Reconstructed trends in median age at first marriage, Congo-Brazzaville



Relationship with education (Figure B-8.2)

The relationship between trends in level of education and in age at marriage was complex, due to unexpected declining trends in level of education and in age at marriage. As a result, in urban areas the relationship changed from steady, to increasing, then to decreasing, and likewise in rural areas.

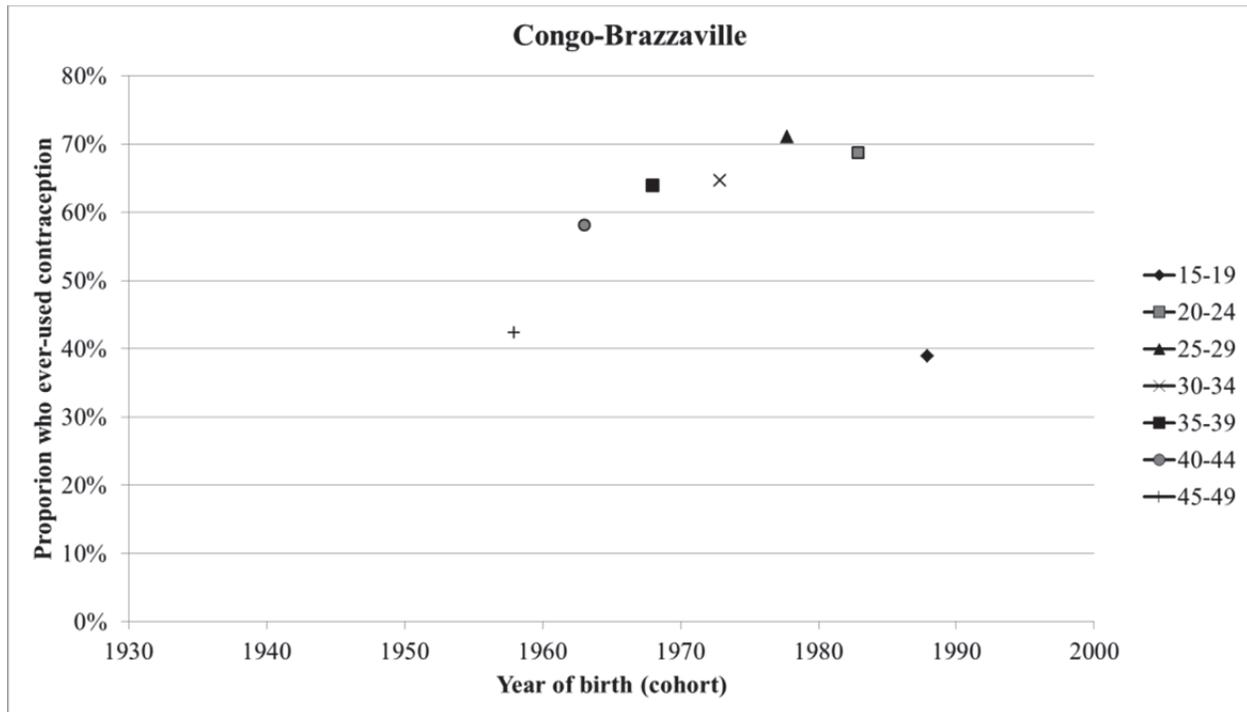
Figure B-8.2. Relationship between level of education and age at first marriage, Congo-Brazzaville



Trends in contraceptive use (Figure B-8.3)

Contraceptive use showed regular cohort and age patterns, with increasing cohort effect (age groups 25-29 to 45-49) and increasing age effect (age groups 15-19 to 25-29). Note the high levels for mid-aged cohorts, above 70%.

Figure B-8.3. Trends in age-specific ever-use of contraception, Congo-Brazzaville



9. Côte d'Ivoire

Four surveys were available in Côte d'Ivoire, conducted in 1980 (WFS), 1994, and 1999 (DHS), and 2005 (AIS). The 2005 AIS survey had no information on contraception.

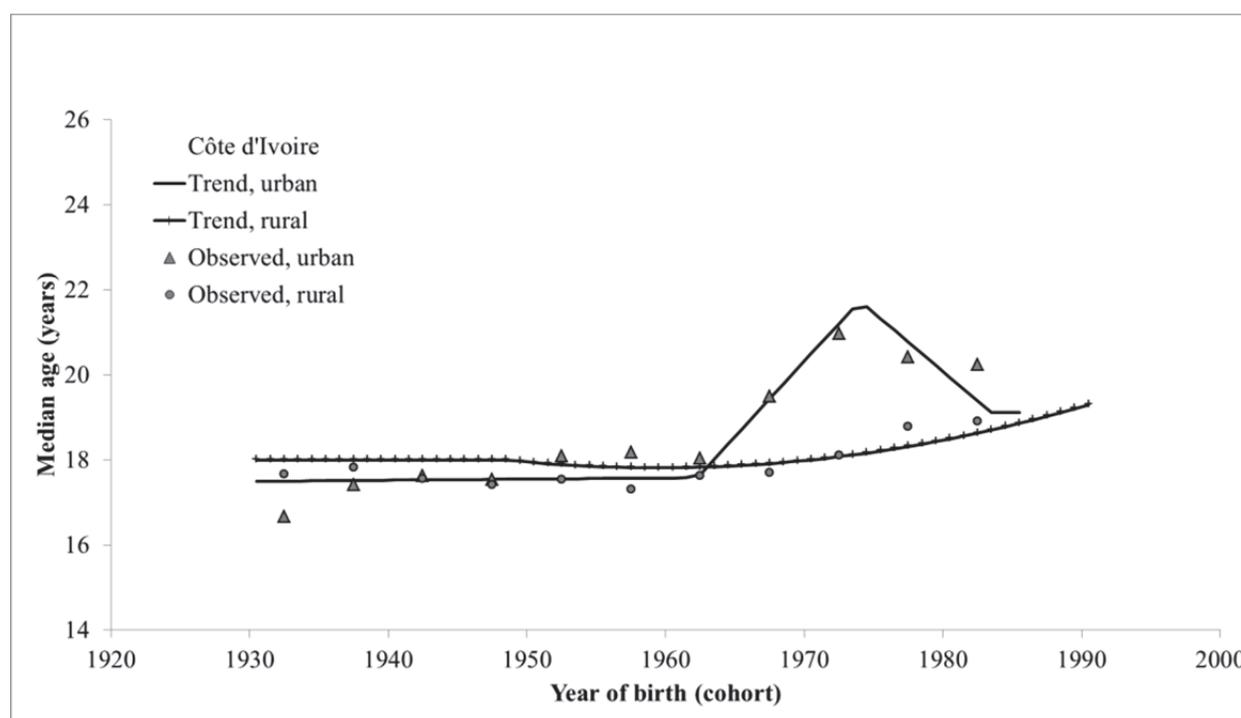
Table B-9.1. Survey characteristics, Côte d'Ivoire

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1980 | 5,764 | 17.3 | 1.30 | 3.0 |
| DHS | 1994 | 8,099 | 18.1 | 2.36 | 23.5 |
| DHS | 1999 | 3,040 | 18.7 | 2.90 | 32.6 |
| AIS | 2005 | 5,183 | 19.3 | 3.04 | |

Trends in age at marriage (Figure B-9.1)

Trends in age at first marriage were irregular in Côte d'Ivoire. In urban areas, after a long period of stagnation, age at marriage increased suddenly (cohorts 1962-1974), then declined as rapidly. In rural areas, after the same period of stagnation at a similar level as in urban areas, it increased slowly, to reach the same level as urban areas around 1985.

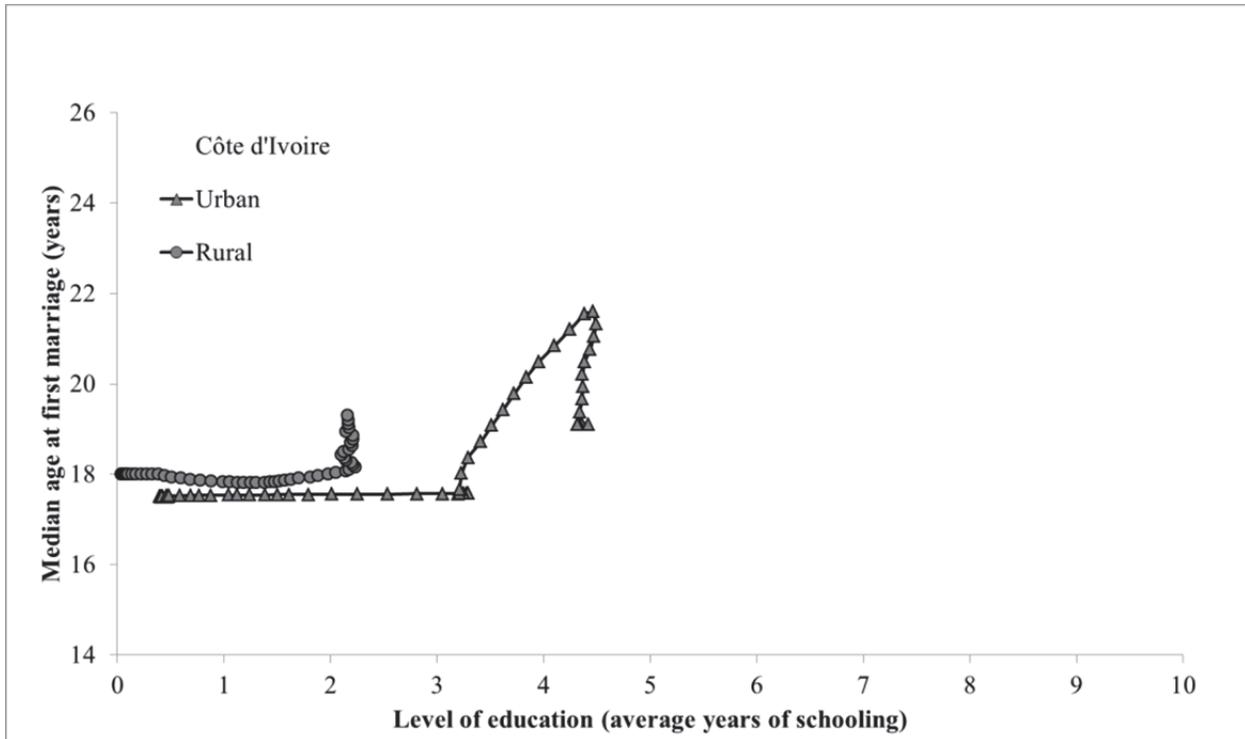
Figure B-9.1. Reconstructed trends in median age at first marriage, Côte d'Ivoire



Relationship with education (Figure B-9.2)

The relationship between trends in level of education and in age at marriage was not linear. The change in trends in urban areas was due to the rise and fall of age at marriage, in a time during which level of education changed little. In rural areas, the increase in age at marriage occurred when level of education remained constant, while age at marriage remained constant when level of education increased.

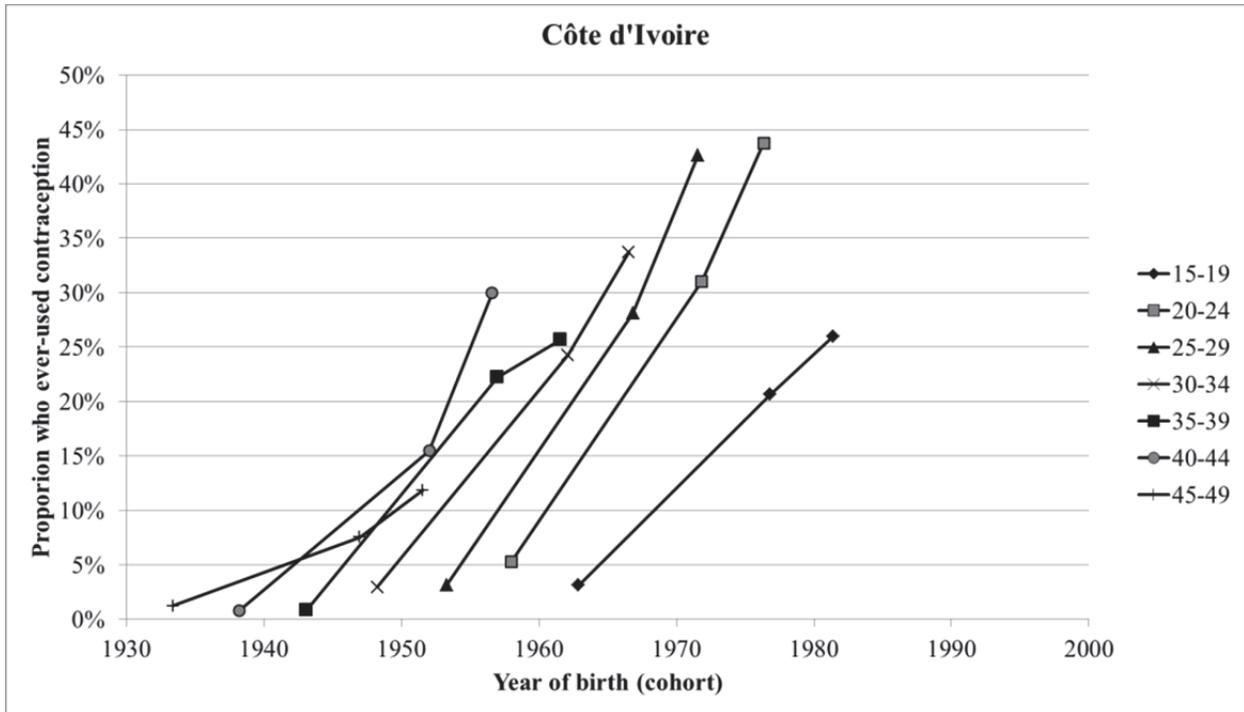
Figure B-9.2. Relationship between level of education and age at first marriage, Côte d'Ivoire



Trends in contraceptive use (Figure B-9.3)

Cohort and age effects of contraceptive use were straightforward in Côte d'Ivoire, with only a small discrepancy for the 45-49 age group (for the same cohorts, the proportion of women who ever-used contraception appeared somewhat lower than in the 40-44 age group). This minor discrepancy seems to be due to the small sample size of this group.

Figure B-9.3. Trends in age-specific ever-use of contraception, Côte d'Ivoire



10. Ethiopia

Three surveys were available in Ethiopia, conducted in 2000, 2005, and 2011. They were compatible for the three variables investigated. The 2011 survey had no information on ever-use of contraception.

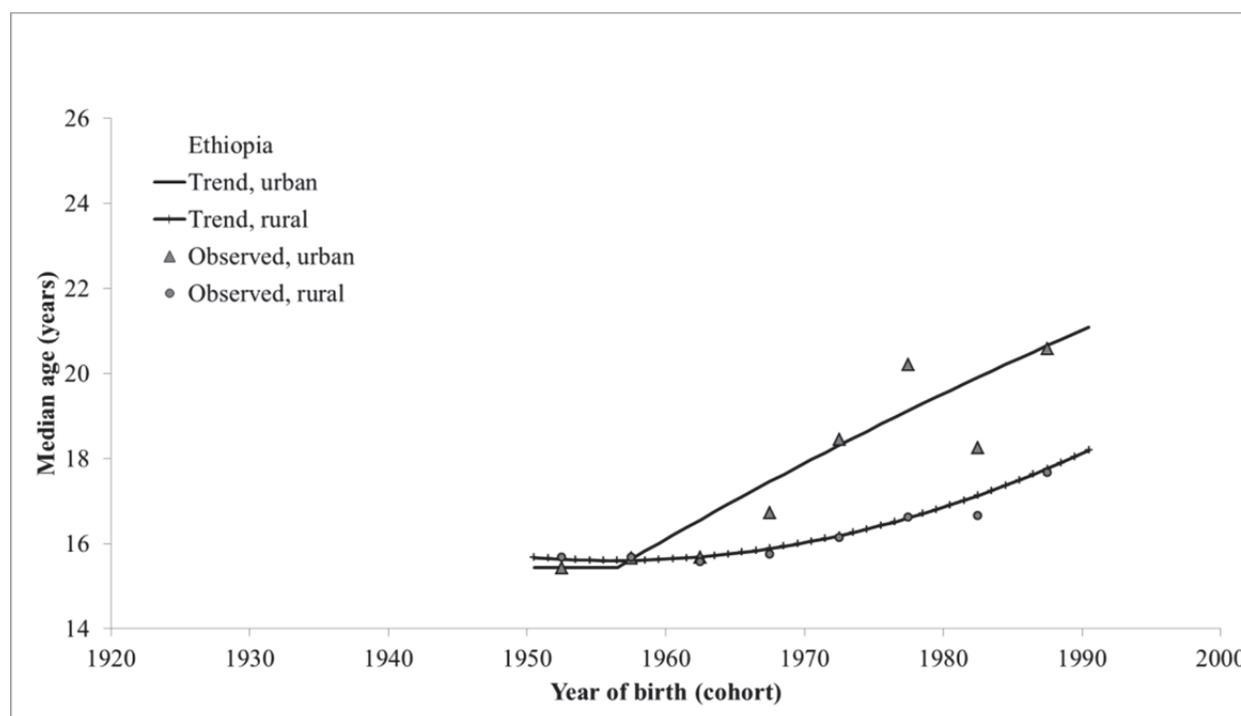
Table B-10.1. Survey characteristics, Ethiopia

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 2000 | 15,367 | 16.0 | 1.30 | 11.0 |
| DHS | 2005 | 14,070 | 16.1 | 1.88 | 17.4 |
| DHS | 2011 | 16,515 | 16.5 | 2.92 | |

Trends in age at marriage (Figure B-10.1)

Age at marriage was increasing steadily in both urban and rural areas for cohorts born after 1955, and was probably at low levels before.

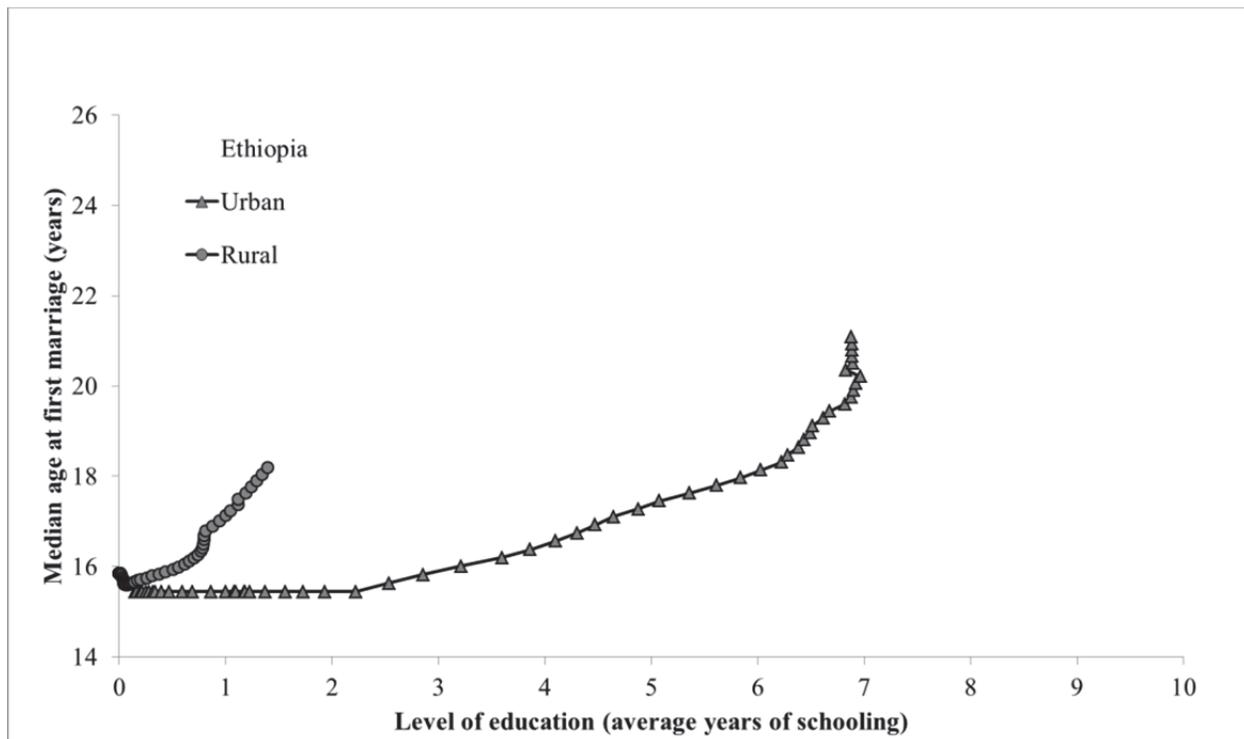
Figure B-10.1. Reconstructed trends in median age at first marriage, Ethiopia



Relationship with education (Figure B-10.2)

The relationship between trends in level of education and in age at marriage was quite regular up to the most recent cohorts in urban areas. This changing pattern in urban areas was due to stagnation in level of education for cohorts 1965-1975 while age at marriage continued to increase.

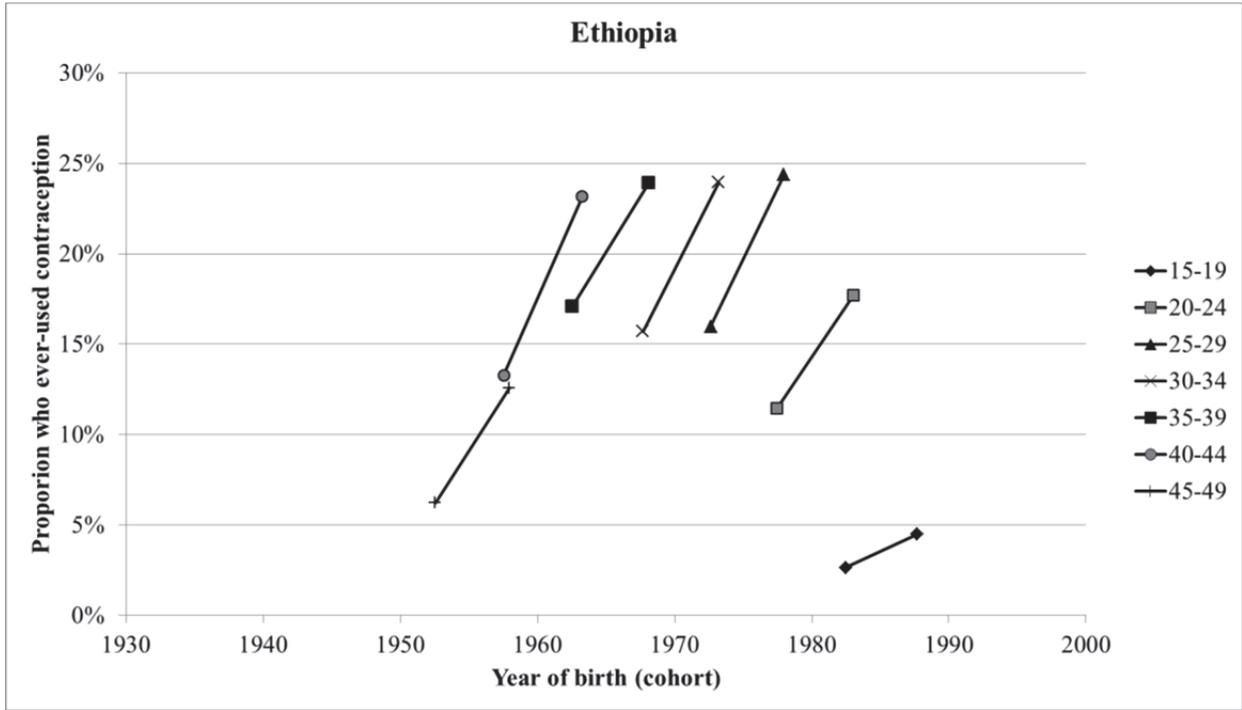
Figure B-10.2. Relationship between level of education and age at first marriage, Ethiopia



Trends in contraceptive use (Figure B-10.3)

Contraceptive use increased steadily for all cohorts available, reaching moderate values for the mid-age groups.

Figure B-10.3. Trends in age-specific ever-use of contraception, Ethiopia



11. Gabon

Two surveys were available in Gabon, conducted in 2000 and 2012. Both were compatible for the same variables, but the second survey had no information on ever-use of contraception.

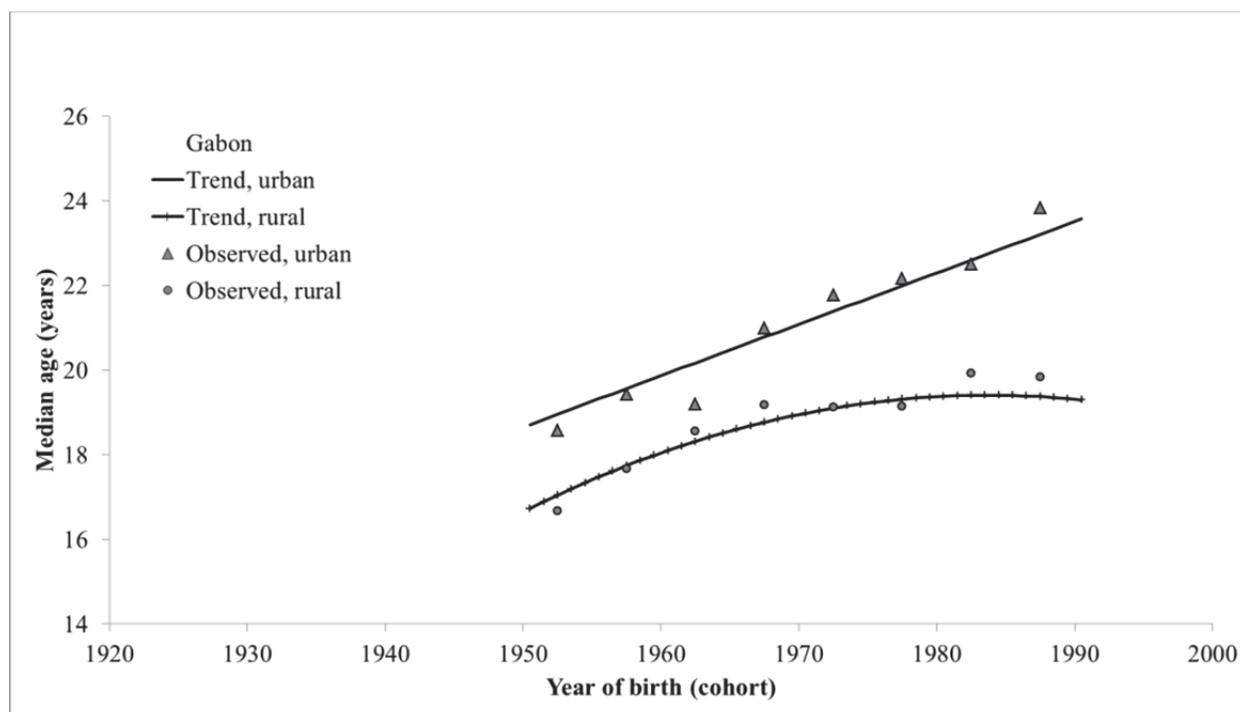
Table B-11.1. Survey characteristics, Gabon

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 2000 | 6,183 | 19.7 | 6.91 | 60.9 |
| DHS | 2012 | 8,422 | 22.0 | 8.30 | |

Trends in age at marriage (Figure B-11.1)

The increase in median age at first marriage was remarkable and steady in urban areas, which account for the majority of the population. In rural areas age at marriage stagnated for cohorts born after 1975, after rising for earlier cohorts.

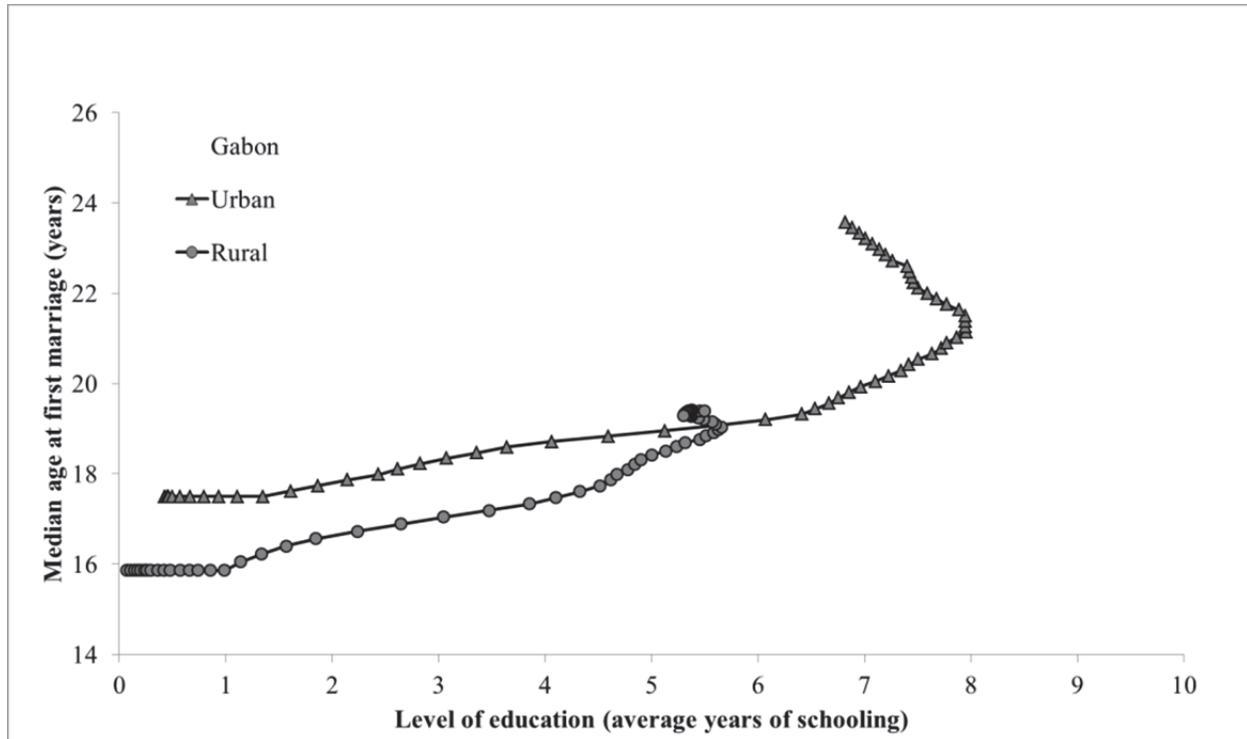
Figure B-11.1. Reconstructed trends in median age at first marriage, Gabon



Relationship with education (Figure B-11.2)

The relationship between trends in level of education and in age at marriage was unexpected. In urban areas, after a steady increase for both, the relationship changed because of a severe decline in level of education (cohorts born after 1955). In rural areas, where the decline in level of education occurred later (cohorts born after 1970), the relationship also changed because of the stagnation in the age at marriage.

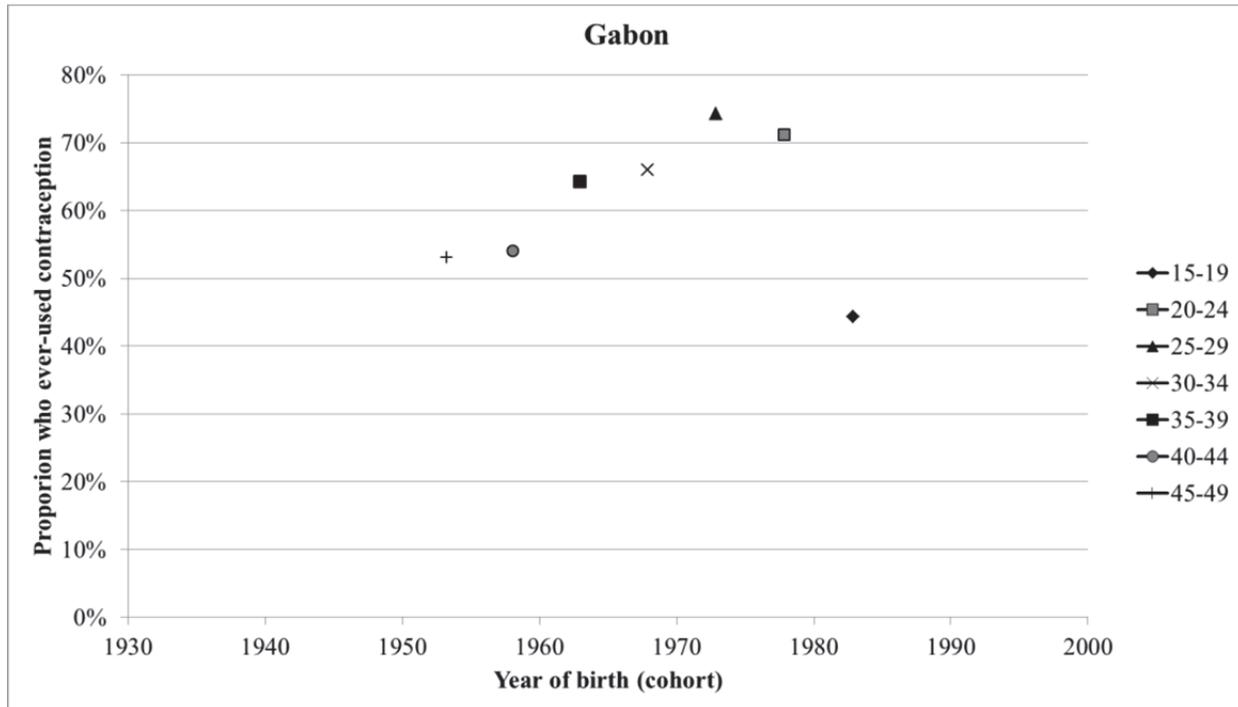
Figure B-11.2. Relationship between level of education and age at first marriage, Gabon



Trends in contraceptive use (Figure B-11.3)

Contraceptive use had the expected pattern of cohort and age effects. Note the highly values, above 70% for the mid-aged cohorts.

Figure B-11.3. Trends in age-specific ever-use of contraception, Gabon



12. Ghana

Six surveys were available in Ghana, starting with the 1979 WFS, and followed by the 1988, 1993, 1999, 2003, and 2008 DHS. All six surveys were compatible for the three variables investigated.

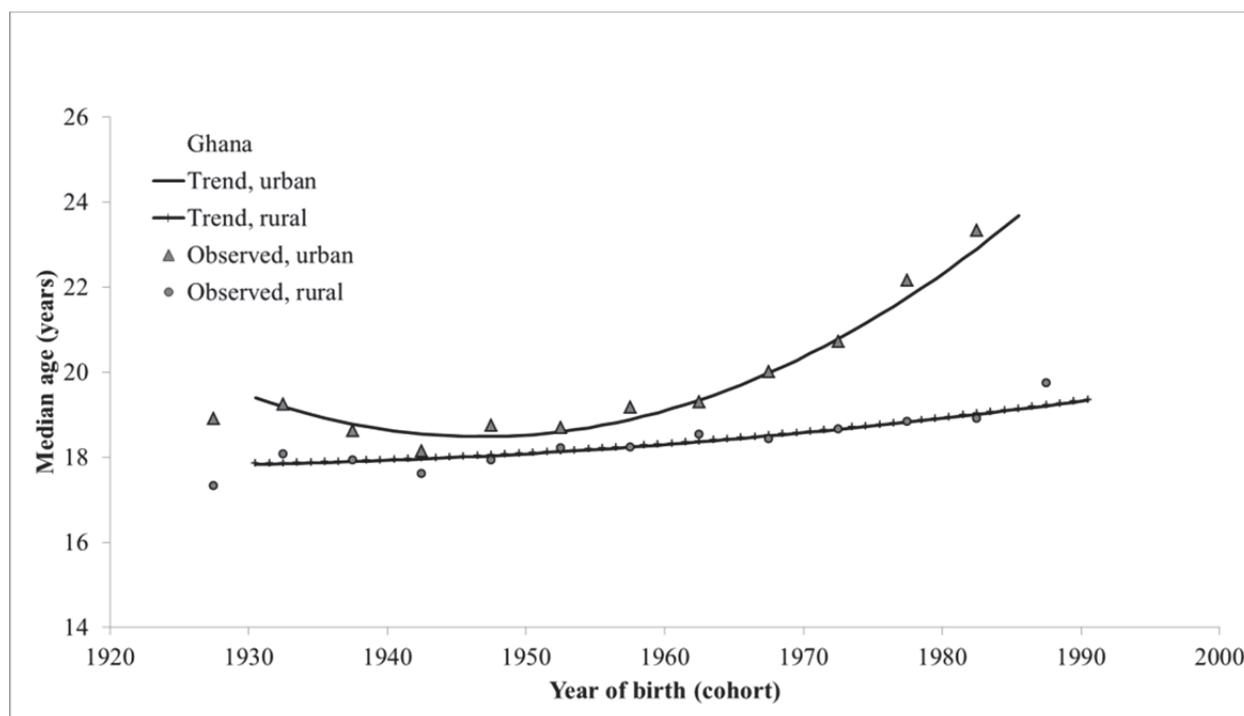
Table B-12.1. Survey characteristics, Ghana

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1979 | 6,125 | 18.1 | 4.14 | 17.7 |
| DHS | 1988 | 4,488 | 18.1 | 4.92 | 20.5 |
| DHS | 1993 | 4,562 | 18.8 | 5.34 | 29.5 |
| DHS | 1999 | 4,843 | 19.1 | 5.97 | 32.9 |
| DHS | 2003 | 5,691 | 19.4 | 5.90 | 38.9 |
| DHS | 2008 | 4,916 | 19.8 | 6.58 | 42.3 |

Trends in age at marriage (Figure B-12.1)

Median age at first marriage was average in Ghana for cohorts born before 1950, somewhat higher but declining in urban areas, and more stable in rural areas. Age at marriage increased markedly for women born after 1950 in urban areas, and increased only marginally in rural areas.

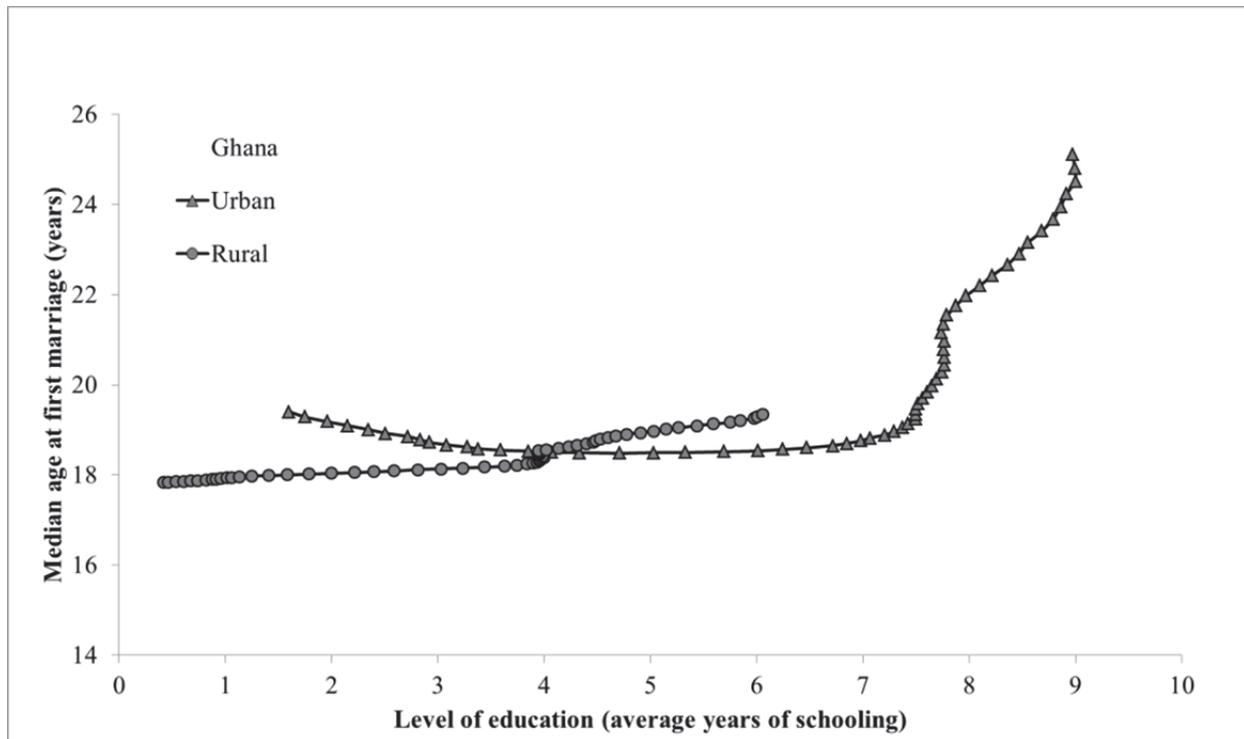
Figure B-12.1. Reconstructed trends in median age at first marriage, Ghana



Relationship with education (Figure B-12.2)

The relationship between trends in level of education and in age at marriage was not linear. In urban areas, age at marriage first declined, then stayed stable, then increased rapidly and continued to increase even when the level of education stagnated. In rural areas, it increased only marginally while the level of education increased rapidly.

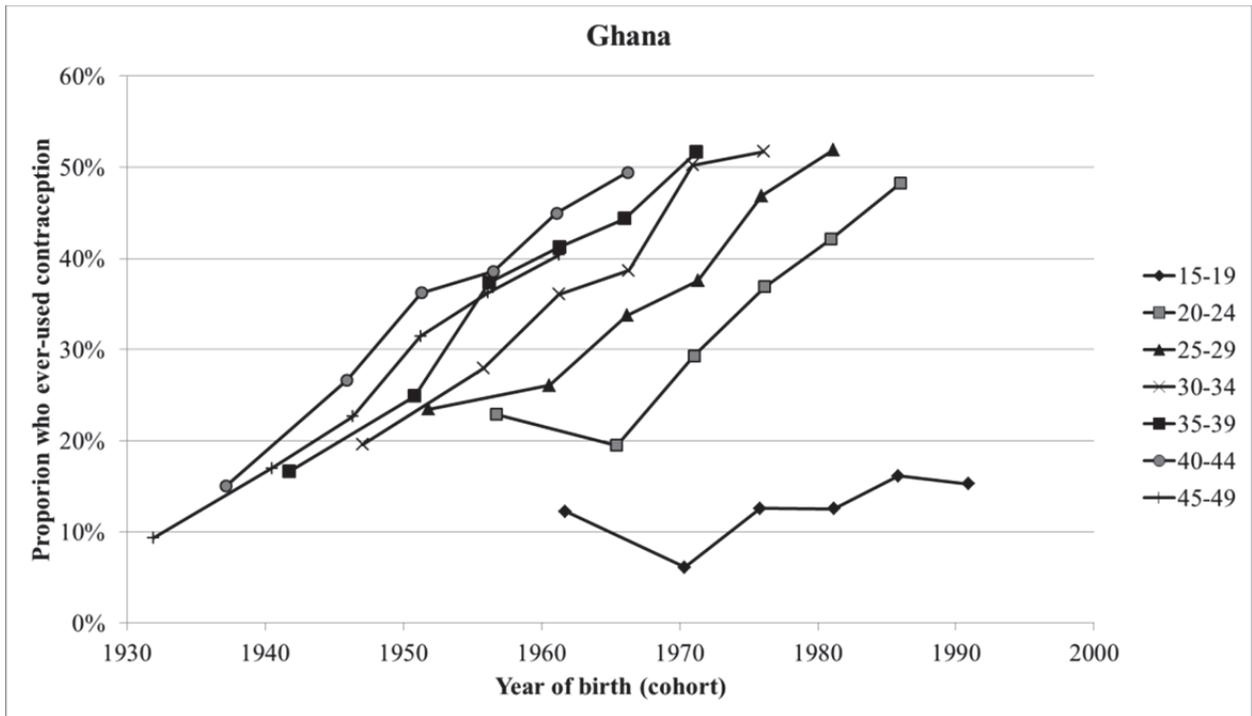
Figure B-12.2. Relationship between level of education and age at first marriage, Ghana



Trends in contraceptive use (Figure B-12.3)

Contraceptive use increased steadily for all cohorts considered, reaching levels above 50% for the mid-age groups. The age pattern was quite regular above age 20. However, the 15-19 age group stayed at a very low level for the cohorts born between 1960 and 1990.

Figure B-12.3. Trends in age-specific ever-use of contraception, Ghana



13. Guinea

Two surveys were available in Guinea, conducted in 1999 and 2005. They were compatible for the three variables analyzed.

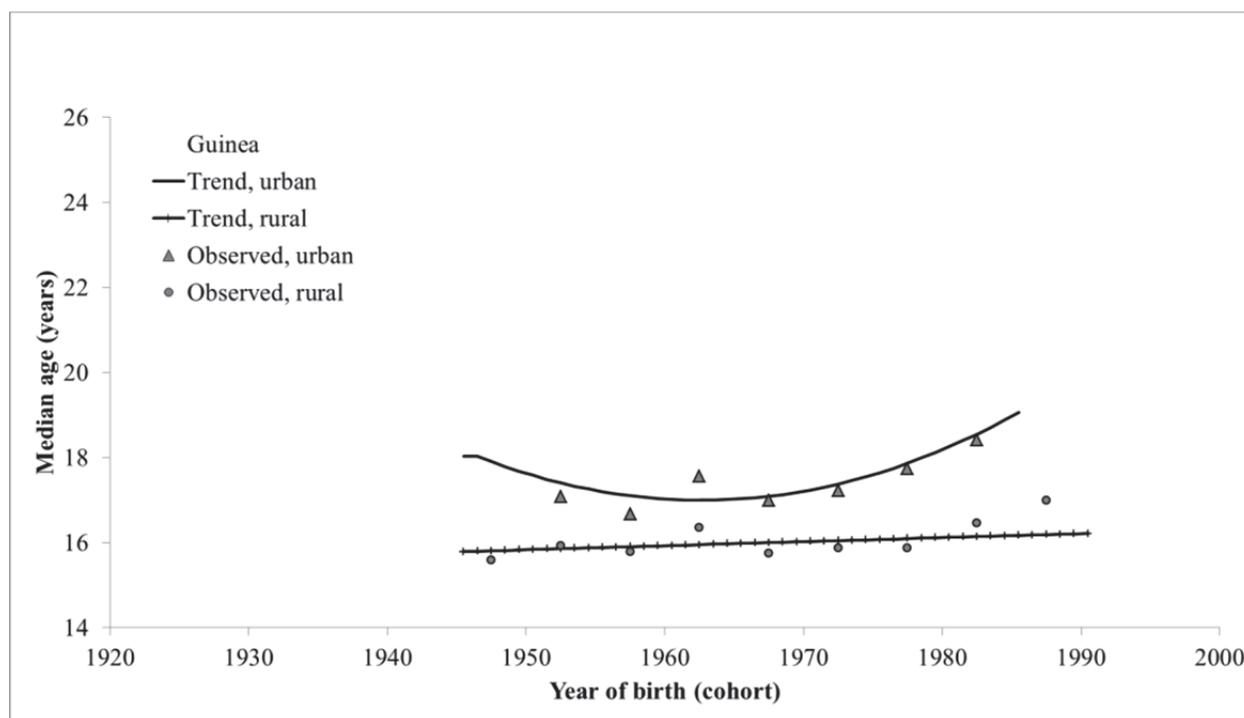
Table B-13.1. Survey characteristics, Guinea

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1999 | 6,753 | 16.4 | 1.40 | 10.3 |
| DHS | 2005 | 7,954 | 16.2 | 1.50 | 16.9 |

Trends in age at marriage (Figure B-13.1)

Median age at first marriage was low and stable in rural areas, and changing in urban areas. In the first phase, it was declining, then rising for cohorts born after 1965.

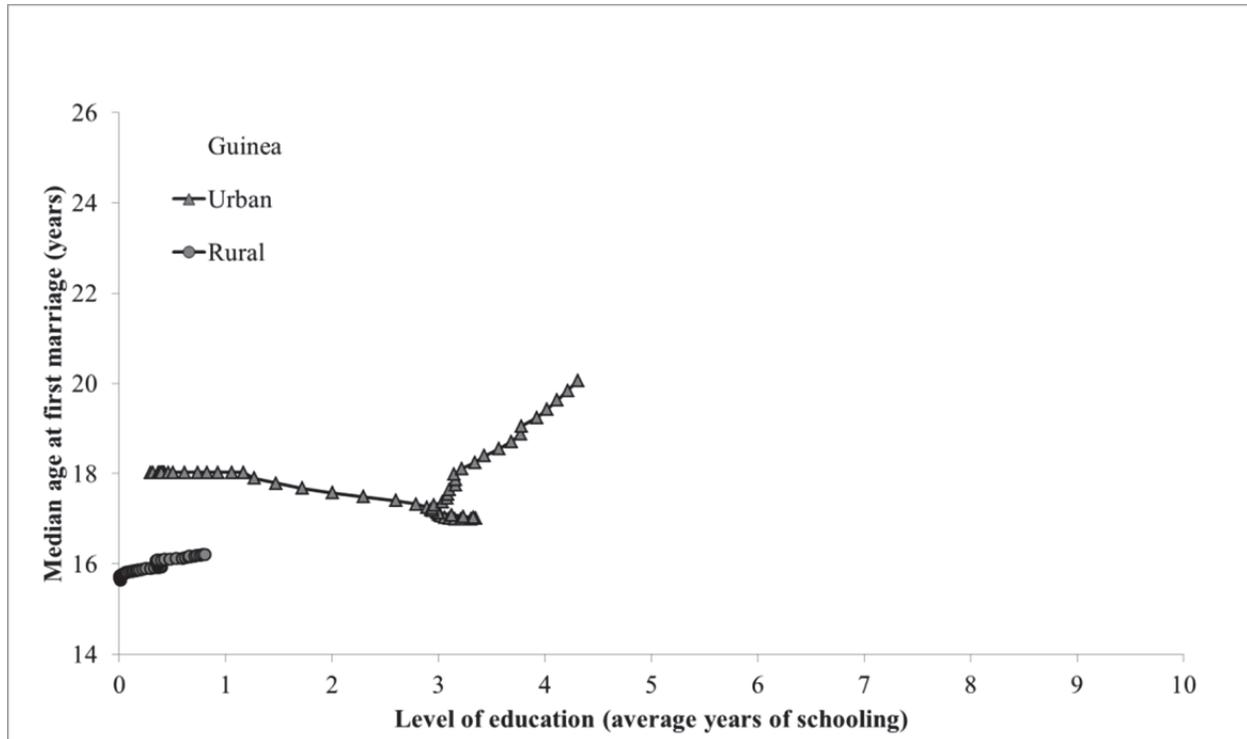
Figure B-13.1. Reconstructed trends in median age at first marriage, Guinea



Relationship with education (Figure B-13.2)

The relationship between trends in level of education and in age at marriage was not linear in urban areas. In the first phase, age at marriage was declining while level of education was increasing, then it continued to decline despite a decline in level of education, then both increased simultaneously. In rural areas, the level of education remained very low.

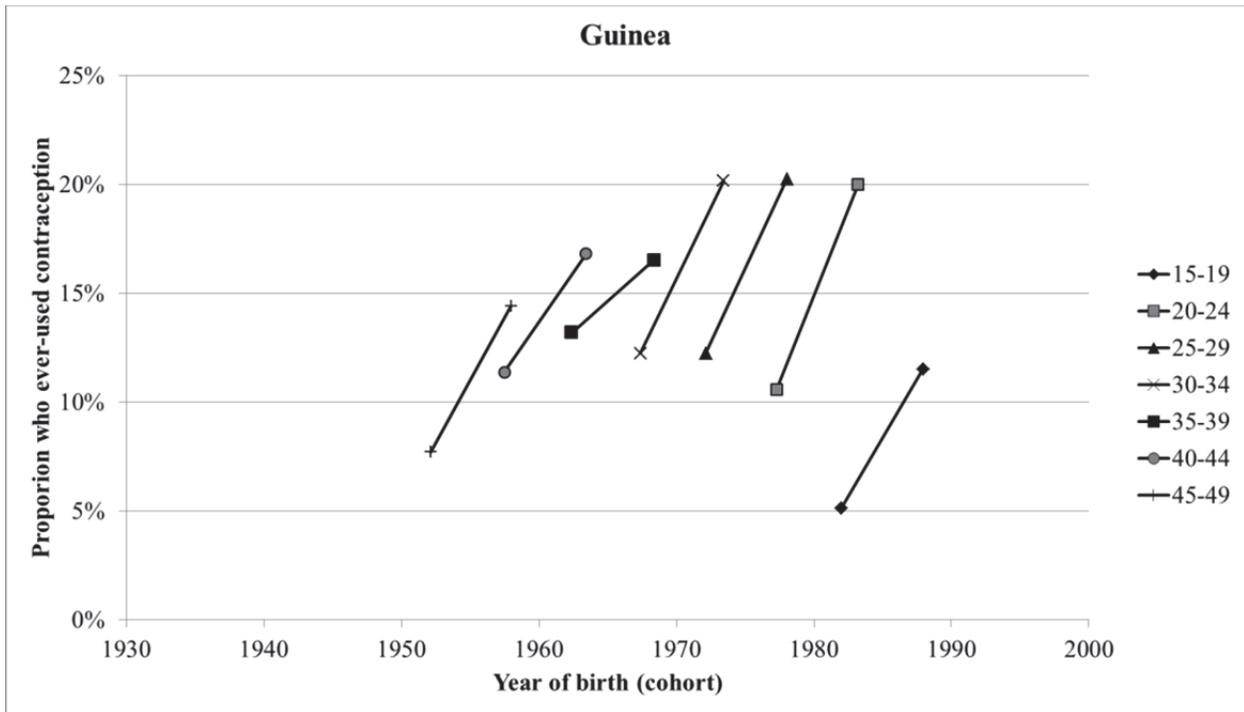
Figure B-13.2. Relationship between level of education and age at first marriage, Guinea



Trends in contraceptive use (Figure B-13.3)

Contraceptive use increased steadily for all cohorts, and the age pattern was as expected. However, the overall proportion of women who ever-used modern contraception remained low, even for the recent cohorts.

Figure B-13.3. Trends in age-specific ever-use of contraception, Guinea



14. Kenya

Kenya has a wealth of high quality data, with six surveys conducted regularly, starting with the 1978 WFS, up to the 2008 DHS. All surveys were compatible with respect to the three variables investigated.

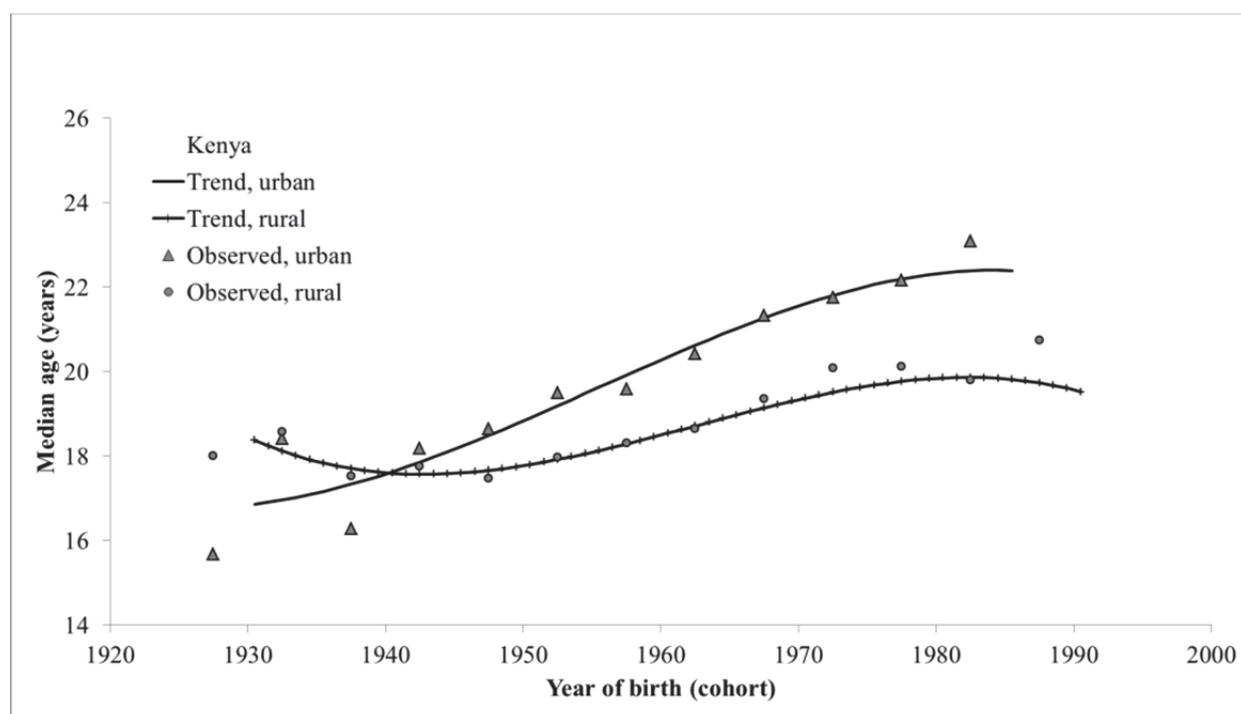
Table B-14.1. Survey characteristics, Kenya

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1978 | 8,100 | 17.8 | 3.34 | 11.1 |
| DHS | 1989 | 7,150 | 18.1 | 5.24 | 24.1 |
| DHS | 1993 | 7,540 | 18.8 | 6.01 | 34.0 |
| DHS | 1998 | 7,881 | 19.2 | 6.90 | 42.2 |
| DHS | 2003 | 8,195 | 19.7 | 7.12 | 43.5 |
| DHS | 2008 | 8,444 | 20.0 | 7.85 | 53.6 |

Trends in age at marriage (Figure B-14.1)

Median age at first marriage appeared to have been lower in urban areas than in rural areas for the early cohorts, born before 1940. Then age at marriage increased steadily in urban areas, whereas in rural areas it first declined somewhat, to increase later, and then to stagnate for cohorts born after 1975.

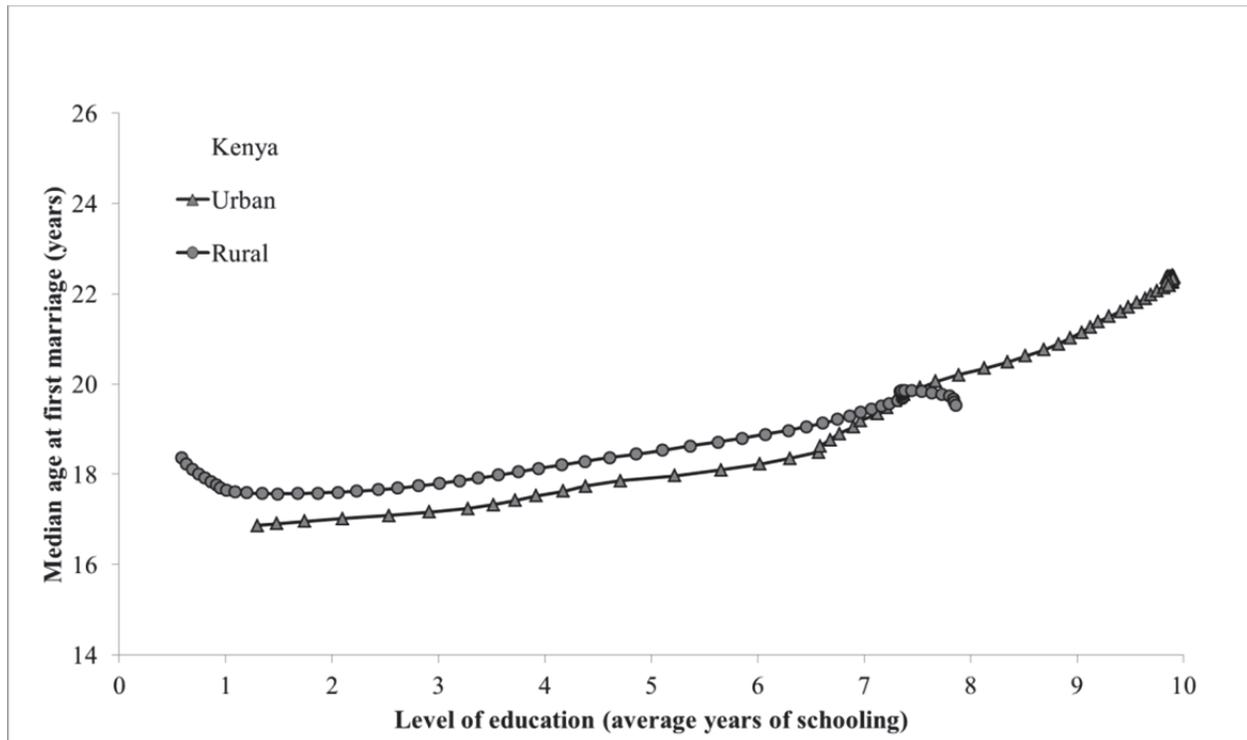
Figure B-14.1. Reconstructed trends in median age at first marriage, Kenya



Relationship with education (Figure B-14.2)

The relationship between trends in level of education and in age at marriage was straightforward, with the exception of the early cohorts in urban areas and the later cohorts in rural areas. Note the high level of education, and the similar relationships in both urban and rural areas.

Figure B-14.2. Relationship between level of education and age at first marriage, Kenya



Trends in contraceptive use (Figure B-14.3)

Cohort trends were marked, and very early, since even cohorts born in the 1930s were already using modern contraception, at least in the old age groups. The age patterns were also quite regular, with the exception of the low values for women age 15-19. Overall, the proportion of women who ever-used contraception was high (above 70% for the mid-age range).

Figure B-14.3. Trends in age-specific ever-use of contraception, Kenya



15. Lesotho

Three surveys were available in Lesotho, starting with the 1977 WFS, and followed by the 2004 and 2009 DHS. The surveys were compatible in the three variables investigated, however the 2009 DHS survey had no information on ever-use of contraception.

Table B-15.1. Survey characteristics, Lesotho

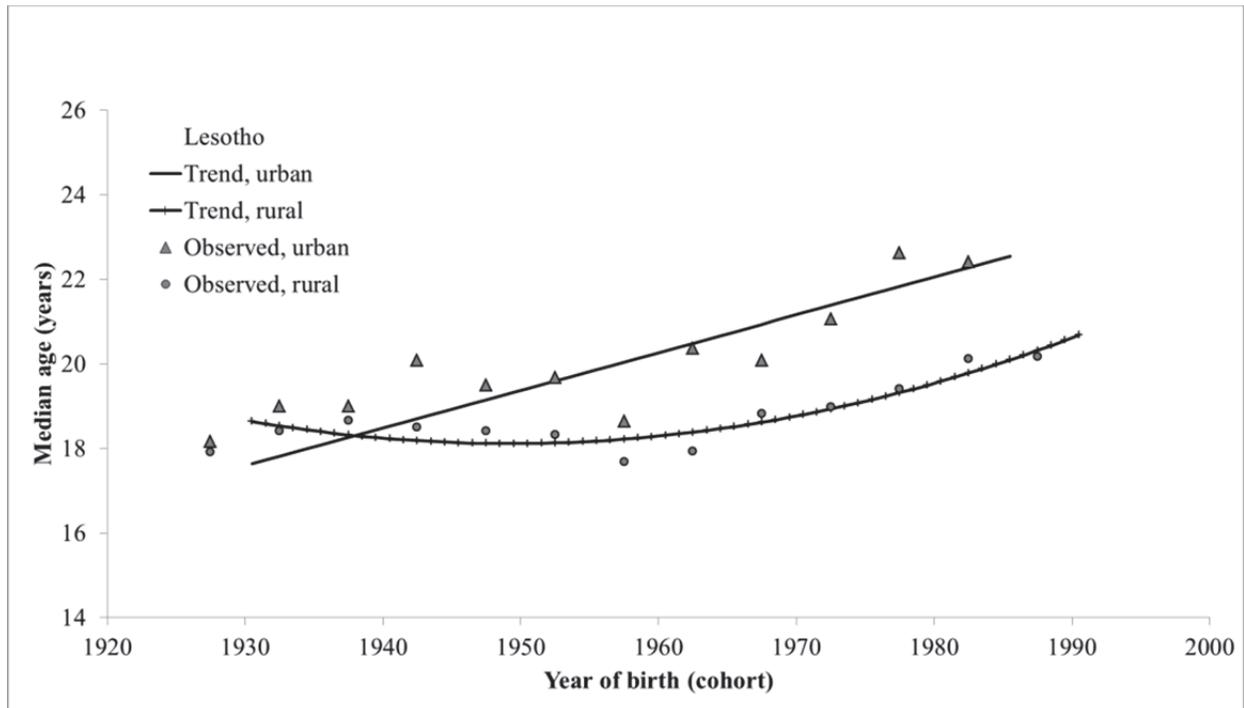
| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1977 | 3,603 | 18.5 | 5.02 | 6.3 |
| DHS | 2004 | 7,095 | 19.1 | 7.29 | 58.7 |
| DHS | 2009 | 7,624 | 19.9 | 8.10 | |

The 1977 sample includes only ever-married women age 15-49. This leads to a bias in the estimation of the median age at marriage, but the bias is believed to be small because almost all women marry by age 40+, both in 2004 (96.0%) and in 2009 (94.4%). The bias was estimated by assuming that 98% of women age 40-49 were ever married in 1977. This would lead to a small change in the median age at marriage: from 18.43 years for the ever married sample to 18.51 years, which is a negligible when compared with an increase of +5.0 years in urban areas and +2.0 years in rural areas. Furthermore, the cohort trends were consistent in the three surveys.

Trends in age at marriage (Figure B-15.1)

Median age at first marriage was average in Lesotho for cohorts born in the 1930, with hardly any difference between urban and rural areas. Age at marriage increased steadily in urban areas, while it first slightly decreased and then increased in rural areas.

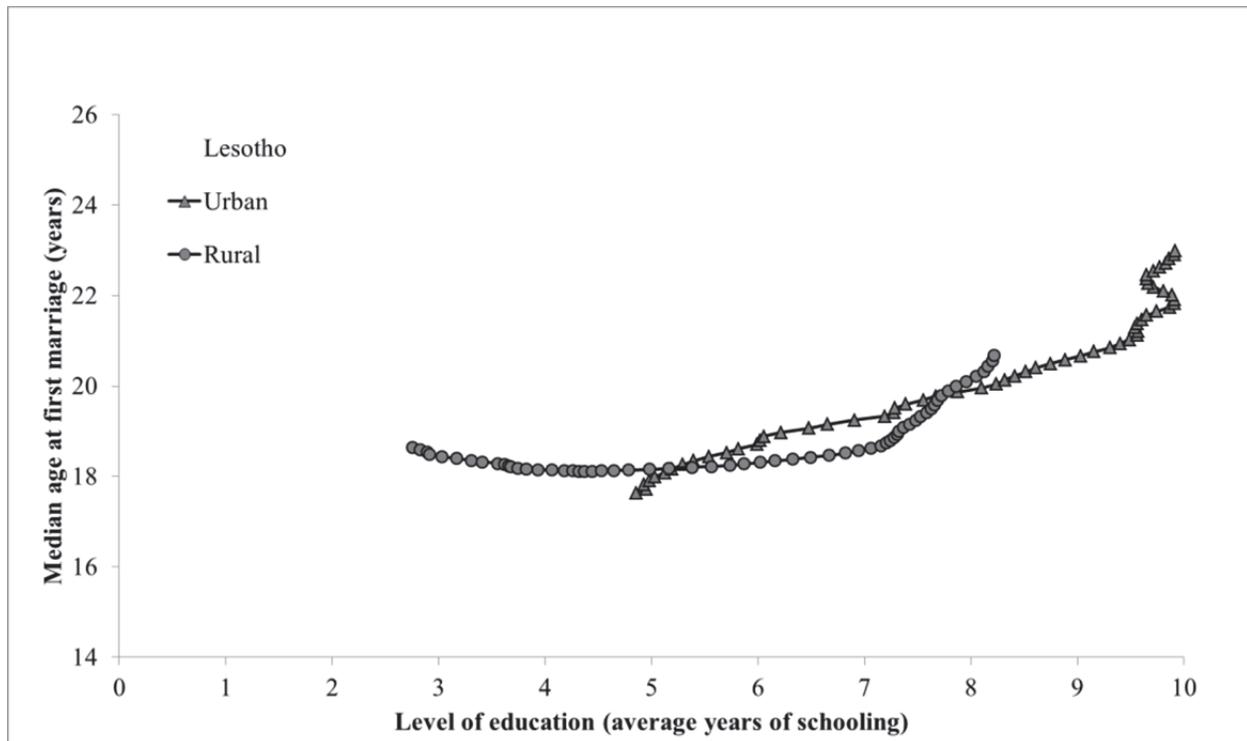
Figure B-15.1. Reconstructed trends in median age at first marriage, Lesotho



Relationship with education (Figure B-15.2)

The relationship between trends in level of education and in age at marriage was quite monotonic in urban areas until the most recent cohorts, where it continued to increase despite a stagnating level of education. In rural areas the changes in age at marriage were not associated with level of education at first, but then both increased rapidly for cohorts born after 1967.

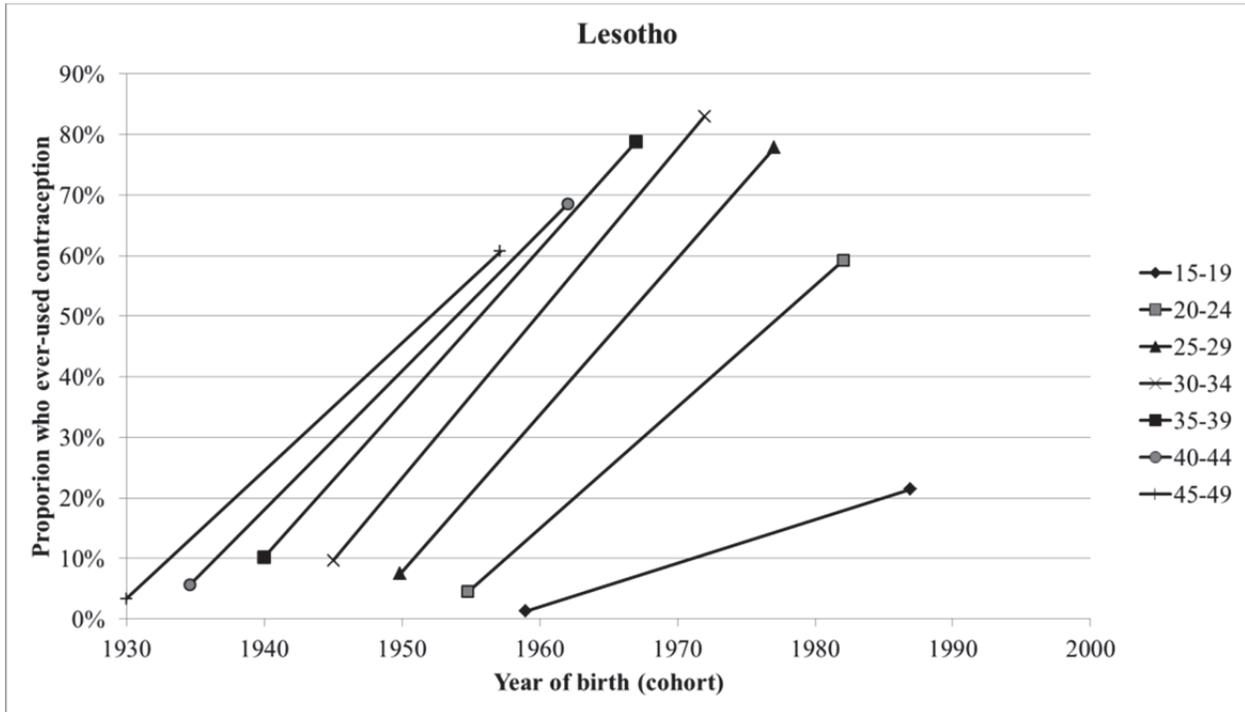
Figure B-15.2. Relationship between level of education and age at first marriage, Lesotho



Trends in contraceptive use (Figure B-15.3)

Contraceptive use increased steadily for all cohorts available, with a regular age pattern except for women age 15-19. Note the high proportion of women who ever-used contraception (> 80% for mid-aged women).

Figure B-15.3. Trends in age-specific ever-use of contraception, Lesotho



16. Liberia

Two surveys were conducted in Liberia in 1986 and 2007. Both were compatible with respect to the three variables analyzed.

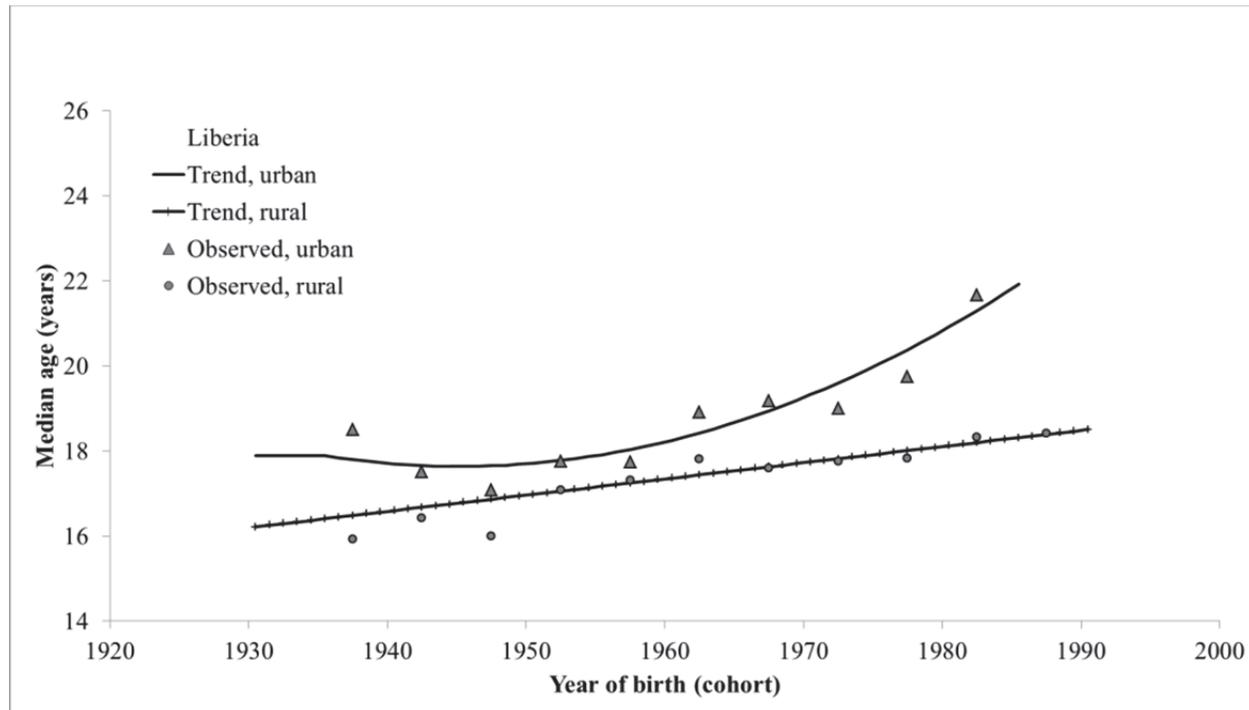
Table B-16.1. Survey characteristics, Liberia

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1986 | 5,239 | 17.2 | 2.59 | 18.6 |
| DHS | 2007 | 7,092 | 18.4 | 3.61 | 32.7 |

Trends in age at marriage (Figure B-16.1)

Median age at first marriage was average in Liberia for cohorts born in the 1930s and 1940s, with a small difference between urban and rural areas. In urban areas, the age at marriage first stagnated, then increased for cohorts born after 1955. In rural areas the increase was regular, but slow.

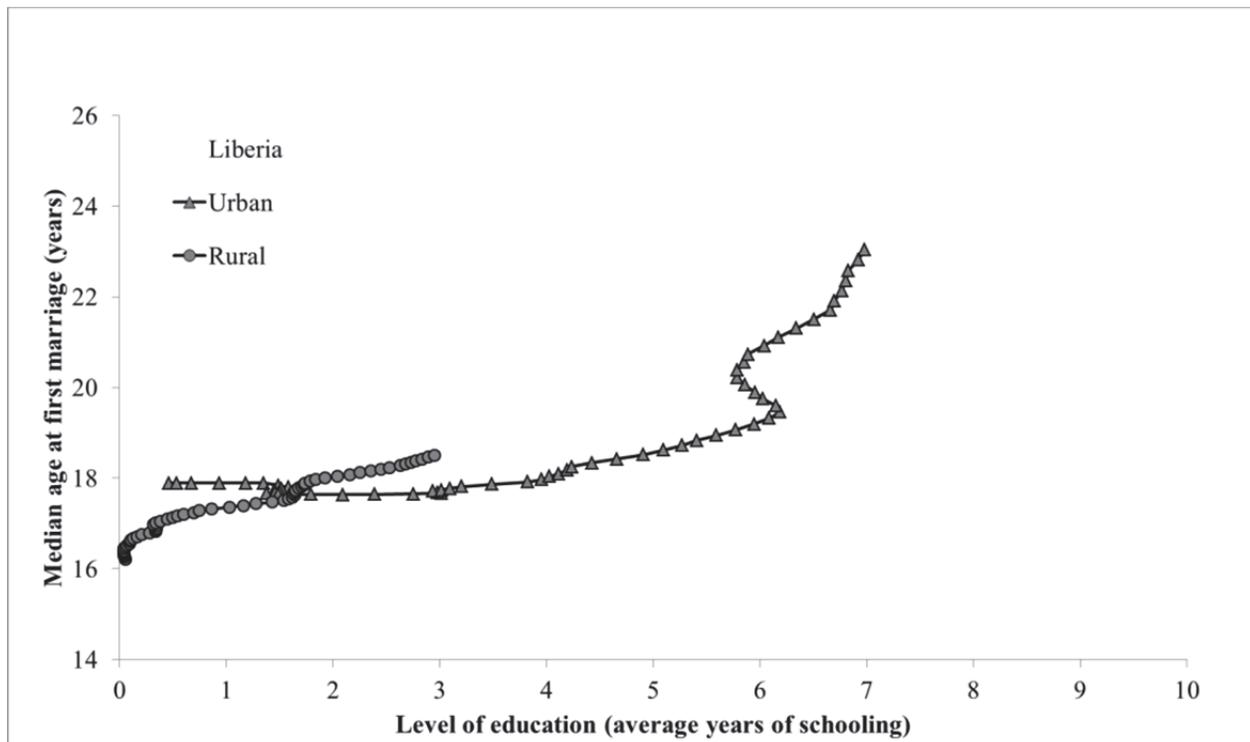
Figure B-16.1. Reconstructed trends in median age at first marriage, Liberia



Relationship with education (Figure B-16.2)

The relationship between trends in level of education and in age at marriage was not linear. In urban areas the relation was at first non-existent, then age at marriage increased slowly while the level of education was increasing, and then it continued to increase despite a decline followed by stagnation in level of education (cohorts born after 1962). In rural areas the relationship was straightforward, but at low levels of both education and age at marriage.

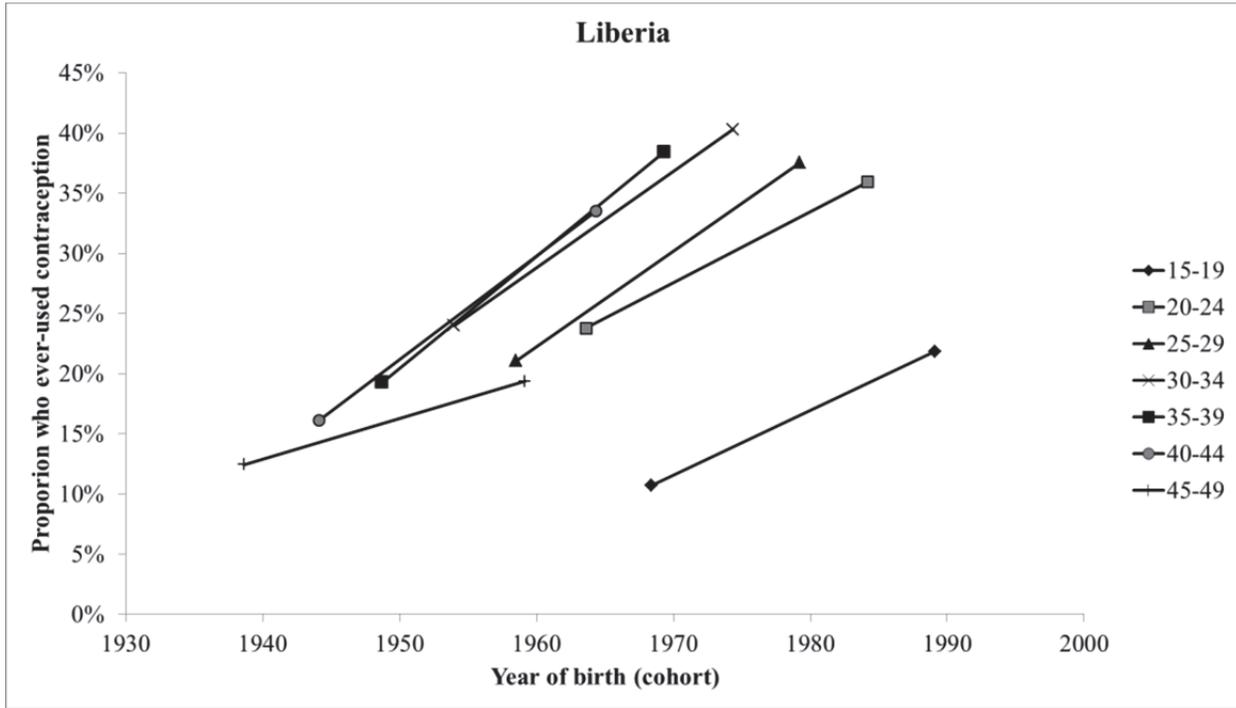
Figure B-16.2. Relationship between level of education and age at first marriage, Liberia



Trends in contraceptive use (Figure B-16.3)

Contraceptive use increased steadily for all cohorts considered, and the age patterns were consistent, with the exception of the 45-49 age group, which was probably due to small sample size.

Figure B-16.3. Trends in age-specific ever-use of contraception, Liberia



17. Madagascar

Four surveys were available in Madagascar, conducted in 1992, 1997, 2003, and 2008. They were compatible for the three variables analyzed. Note that the lower age at marriage and lower level of education in 2008 survey compared with the 2003 survey are real effects, as will be seen below.

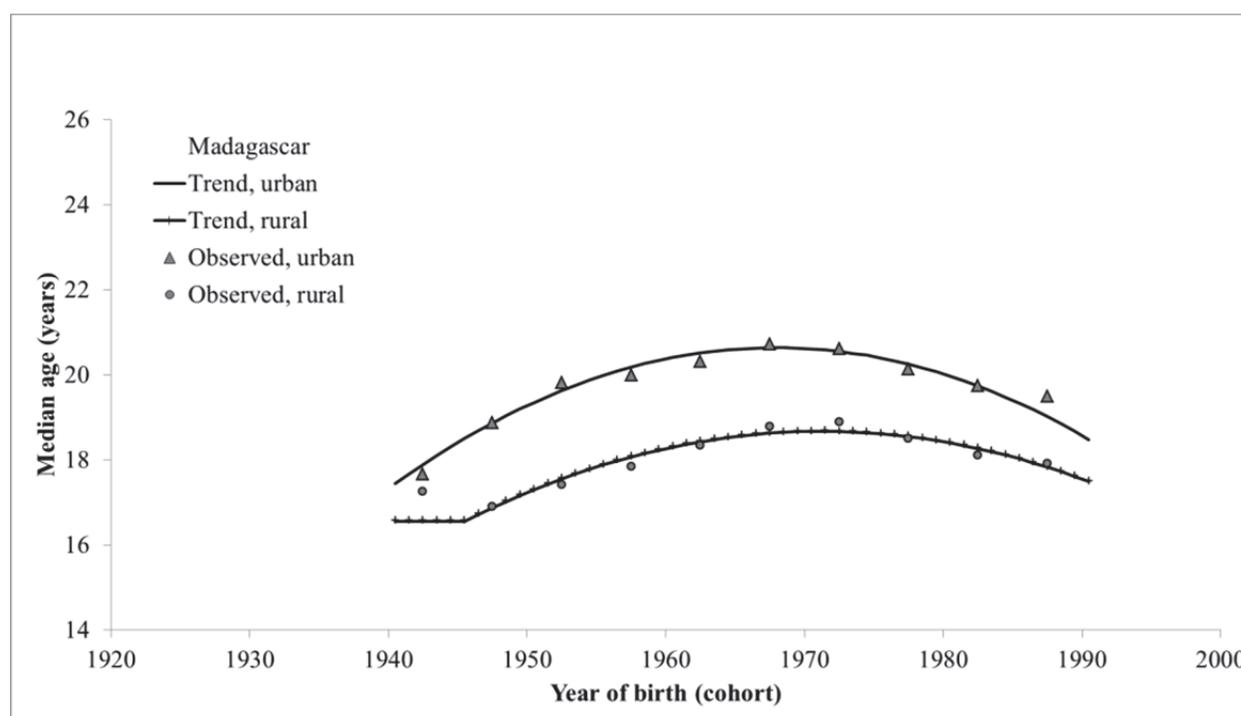
Table B-17.1. Survey characteristics, Madagascar

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1992 | 6,260 | 18.2 | 3.71 | 8.3 |
| DHS | 1997 | 7,060 | 18.5 | 3.74 | 13.9 |
| DHS | 2003 | 7,949 | 19.1 | 4.49 | 31.3 |
| DHS | 2008 | 17,375 | 18.9 | 4.28 | 40.8 |

Trends in age at marriage (Figure B-17.1)

Median age at first marriage was average in Madagascar for cohorts born in the 1940s, with a small difference between urban and rural areas. In both urban and rural areas, age at marriage first increased, then declined, a pattern markedly different from most other countries.

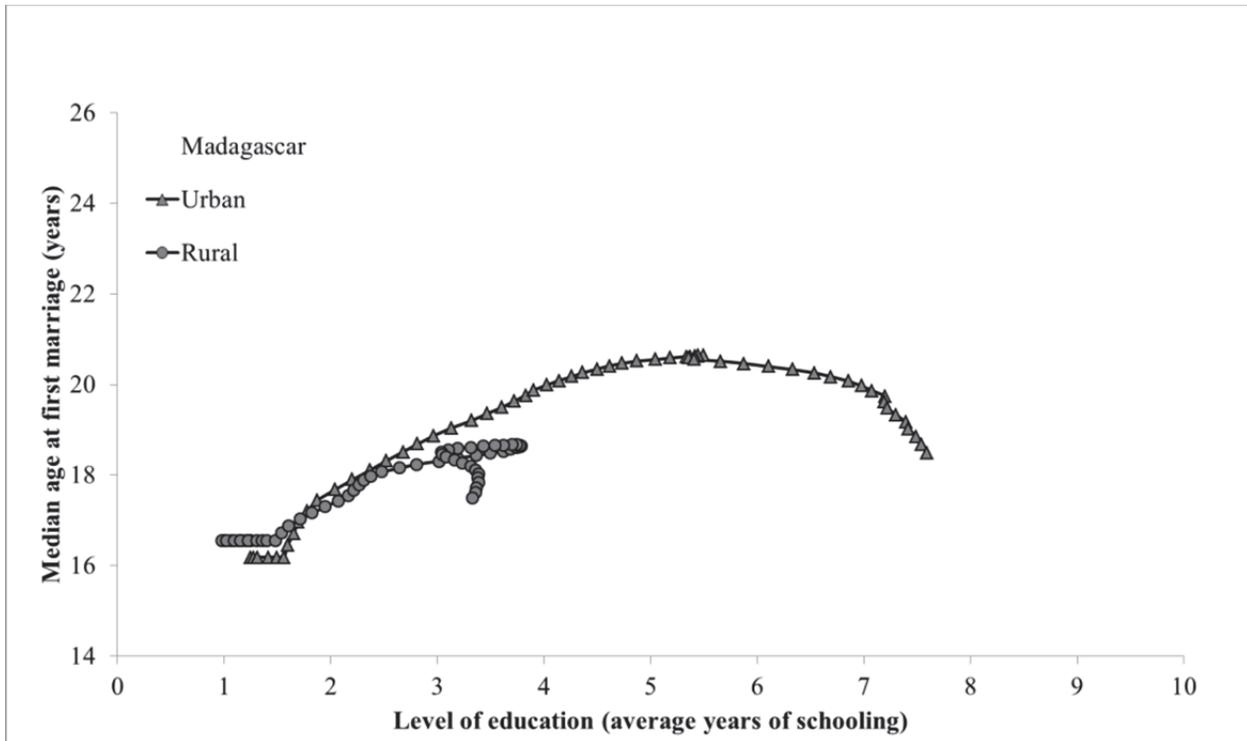
Figure B-17.1. Reconstructed trends in median age at first marriage, Madagascar



Relationship with education (Figure B-17.2)

The relationship between trends in level of education and in age at marriage was not linear, partly because of the trends in age at marriage, and partly because of irregular trends in level of education. In urban areas both changes were roughly concomitant for a while, and then the declining age at marriage prevailed, despite an increasing level of education. In rural areas, the pattern was more complex, with stagnation of the age at marriage when the level of education declined, and decline in age at marriage when level of education remained unchanged.

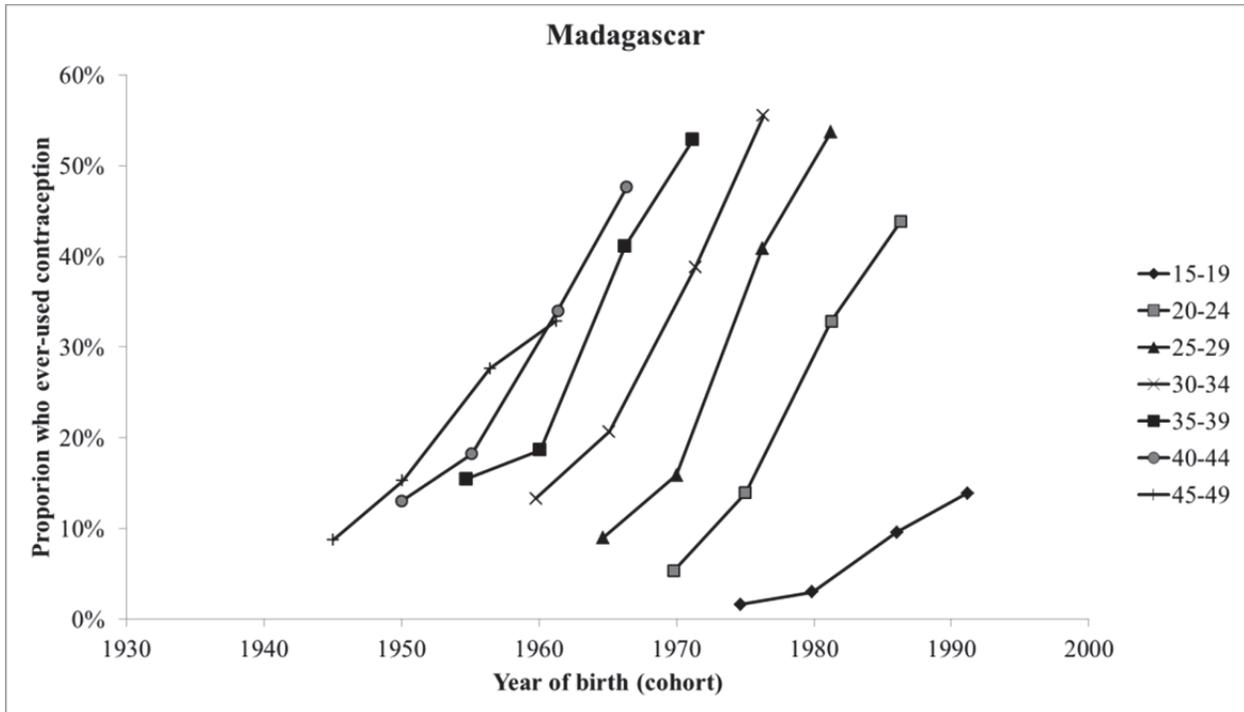
Figure B-17.2. Relationship between level of education and age at first marriage, Madagascar



Trends in contraceptive use (Figure B-17.3)

In contrast with the complex changes noted above, contraceptive use increased steadily for all cohorts considered, reaching relatively high levels for the mid-age groups. The age pattern was regular, with the exception of the 15-19 age group, which remained at low levels, although increasing steadily in the recent cohorts.

Figure B-17.3. Trends in age-specific ever-use of contraception, Madagascar



18. Malawi

Four surveys were conducted in Malawi, in 1992, 2000, 2004, and 2010. They were compatible in the three variables investigated.

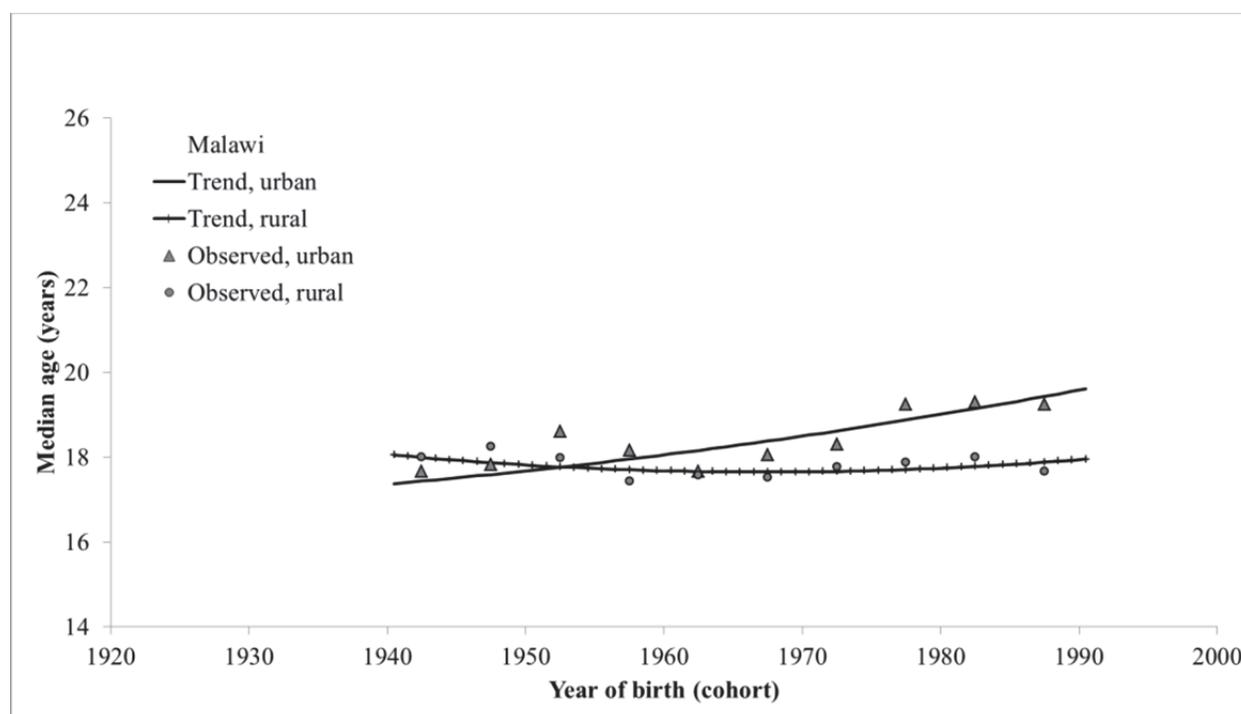
Table B-18.1. Survey characteristics, Malawi

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1992 | 4,849 | 17.8 | 2.31 | 16.9 |
| DHS | 2000 | 13,220 | 17.8 | 3.99 | 38.6 |
| DHS | 2004 | 11,698 | 17.9 | 4.71 | 46.3 |
| DHS | 2010 | 23,020 | 17.8 | 5.35 | 61.8 |

Trends in age at marriage (Figure B-18.1)

Median age at first marriage was average in Malawi for cohorts born in the 1950s, with hardly any difference between urban and rural areas. Age at marriage increased somewhat in urban areas for cohorts born after 1960, while remaining roughly constant in rural areas.

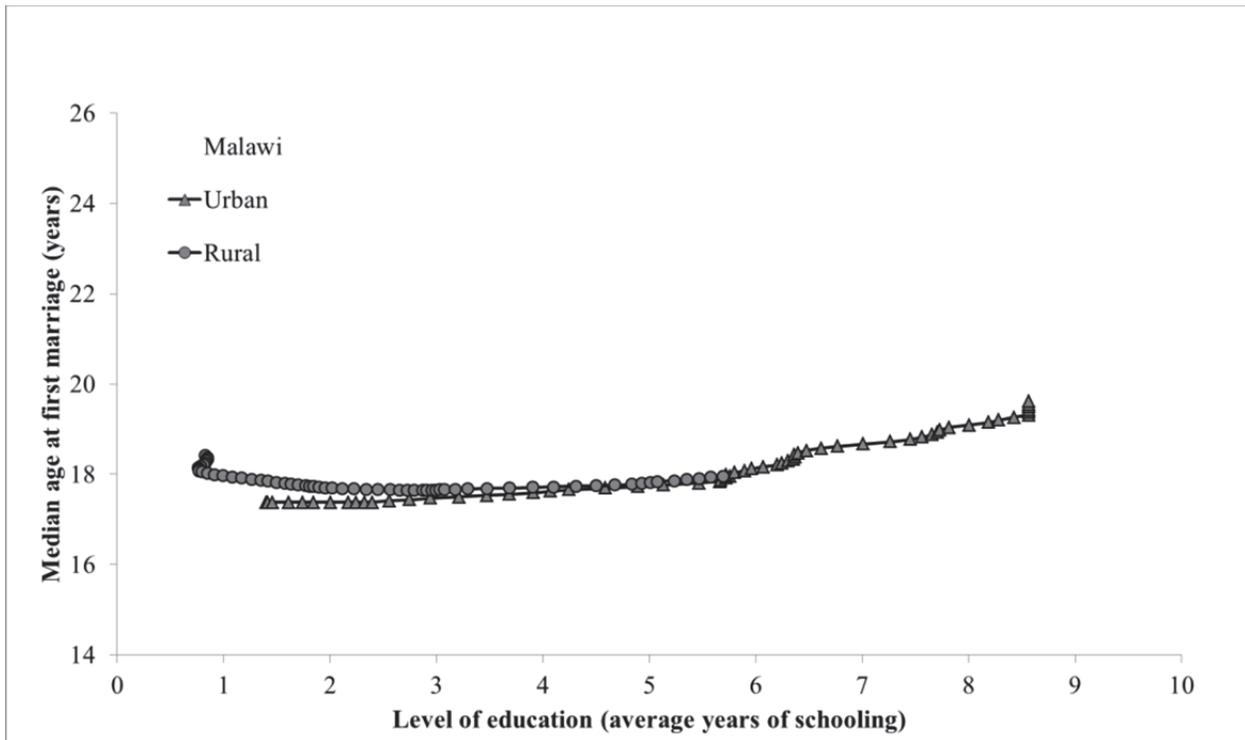
Figure B-18.1. Reconstructed trends in median age at first marriage, Malawi



Relationship with education (Figure B-18.2)

The relationship between trends in level of education and in age at marriage was hardly visible, with a very small change in age at marriage associated with a major increase in level of education. The relationship was basically the same in urban and rural areas.

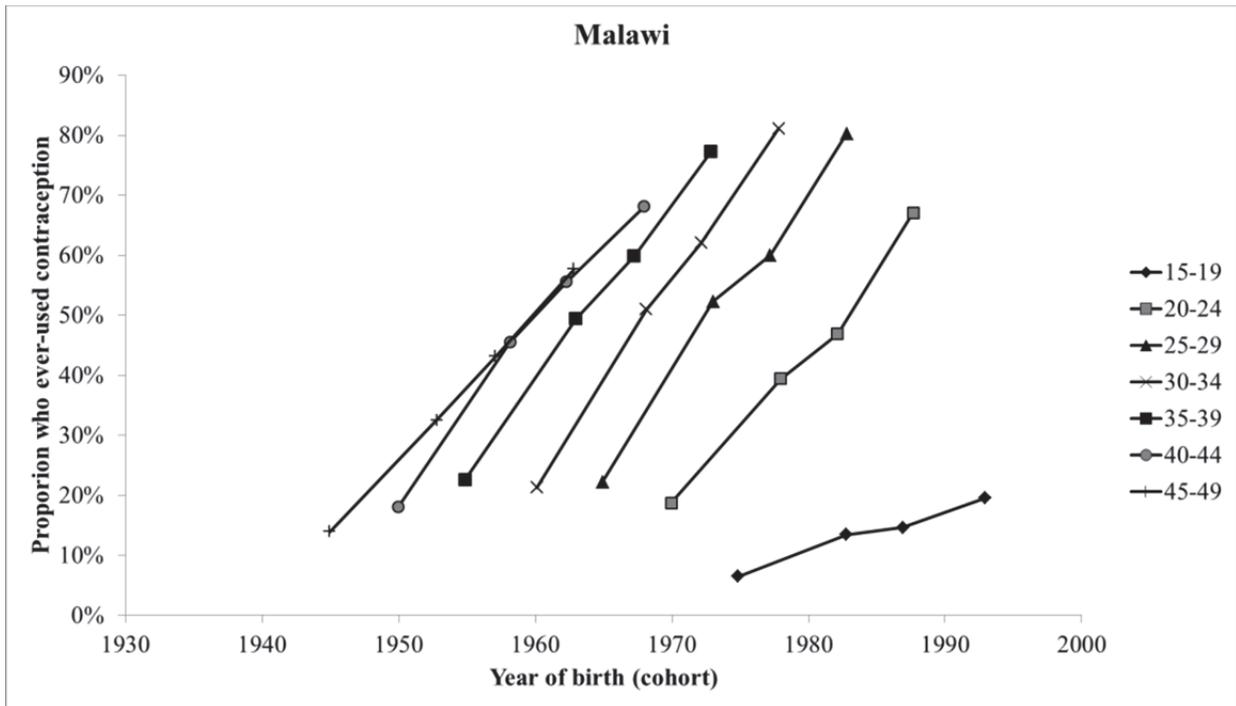
Figure B-18.2. Relationship between level of education and age at first marriage, Malawi



Trends in contraceptive use (Figure B-18.3)

Contraceptive use increased steadily for all cohorts considered. The age pattern was also consistent, with the 15-19 age group at much lower levels. Otherwise, the proportion of women who ever-used contraception reached high values (> 80%) for mid-age groups.

Figure B-18.3. Trends in age-specific ever-use of contraception, Malawi



19. Mali

Four surveys were available in Mali, conducted in 1987, 1996, 2001, and 2006. They were compatible in the three variables investigated, each with low values, with the exception of contraceptive use in the last survey found lower than expected from previous trends.

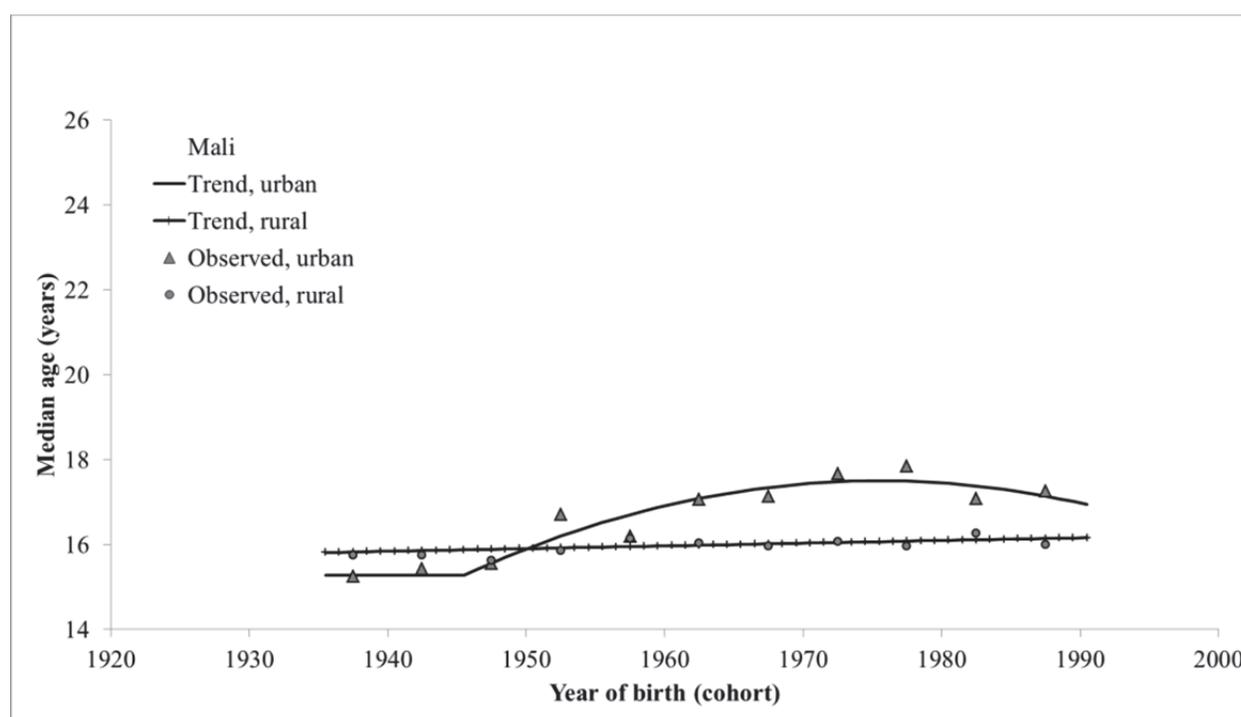
Table B-19.1. Survey characteristics, Mali

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1987 | 3,200 | 15.7 | 0.86 | 3.2 |
| DHS | 1996 | 9,704 | 16.0 | 1.01 | 12.4 |
| DHS | 2001 | 12,849 | 16.5 | 1.28 | 20.1 |
| DHS | 2006 | 14,583 | 16.6 | 1.42 | 17.5 |

Trends in age at marriage (Figure B-19.1)

Median age at first marriage was very low in Mali for cohorts born before the 1950s, with hardly any difference between urban and rural areas. Age at marriage increased somewhat in urban areas for cohorts 1950-1975, then stagnated and even declined slightly for the most recent cohorts. There was no change in age at marriage in rural areas.

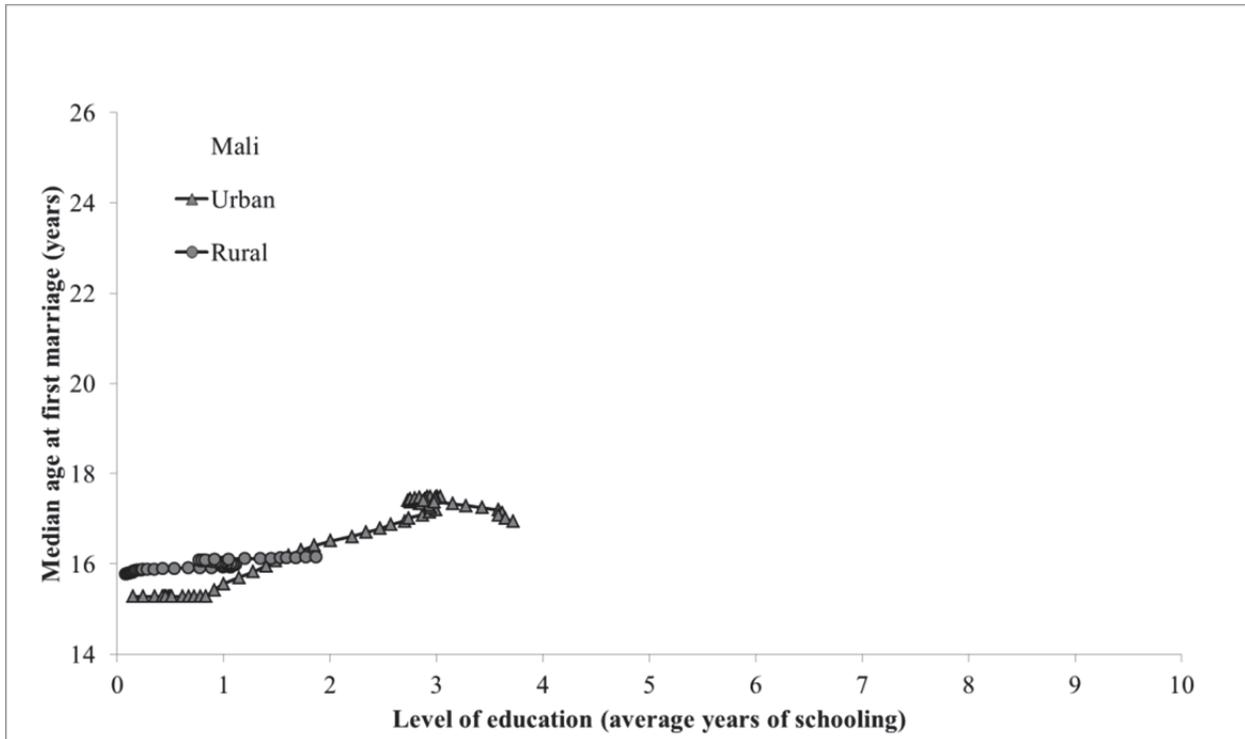
Figure B-19.1. Reconstructed trends in median age at first marriage, Mali



Relationship with education (Figure B-19.2)

The relationship between trends in level of education and in age at marriage was limited due to the small magnitude of change in both variables. The relationship was roughly linear in both urban and rural areas, with a small loop in urban areas due to stagnation or mild decline in level of education, and a slightly inversed relationship in the recent cohorts.

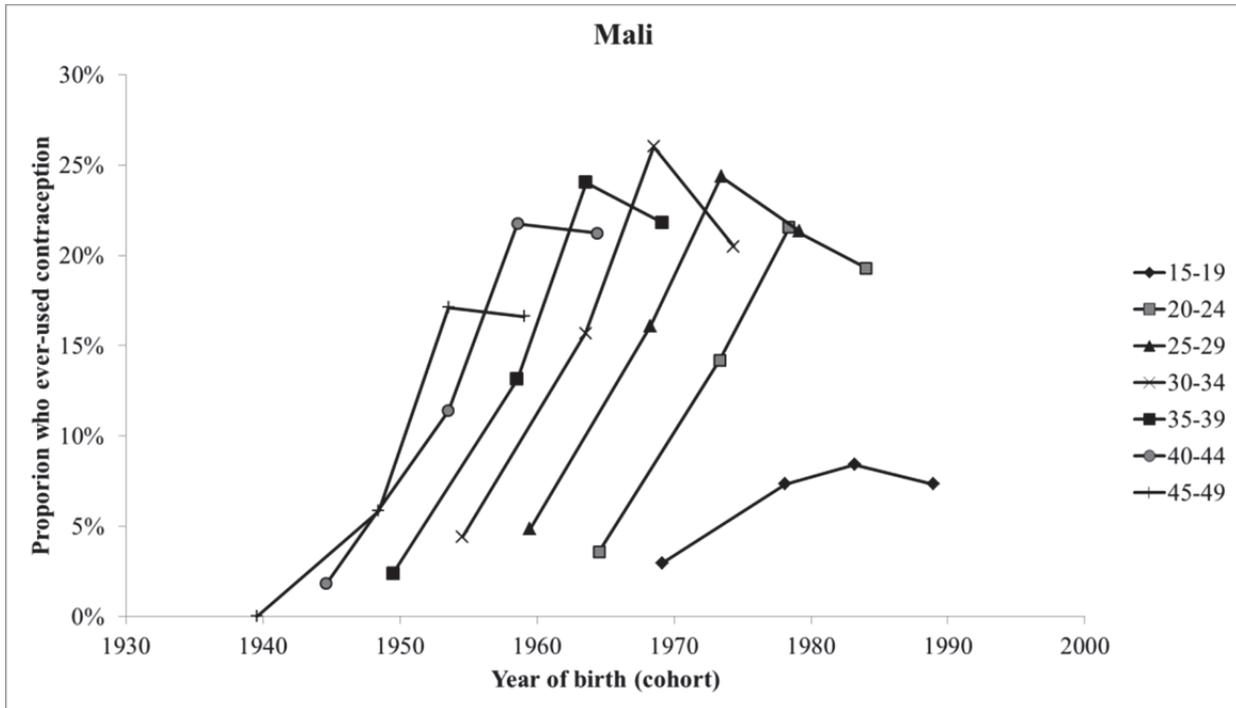
Figure B-19.2. Relationship between level of education and age at first marriage, Mali



Trends in contraceptive use (Figure B-19.3)

In contrast, trends in contraceptive use were steady for cohorts before the 2006 survey. In this survey the proportion of women who ever-used contraception stagnated or declined for all age groups, which is surprising and might be due to an over-estimation in the 2001 survey followed by an under-estimation in the 2006 survey. This point would require further investigation.

Figure B-19.3. Trends in age-specific ever-use of contraception, Mali



20. Mozambique

Three surveys were available in Mozambique, conducted in 1997, 2003, and 2011. They were compatible in the three variables investigated. However, the 2011 survey did not include information on ever-use of contraception.

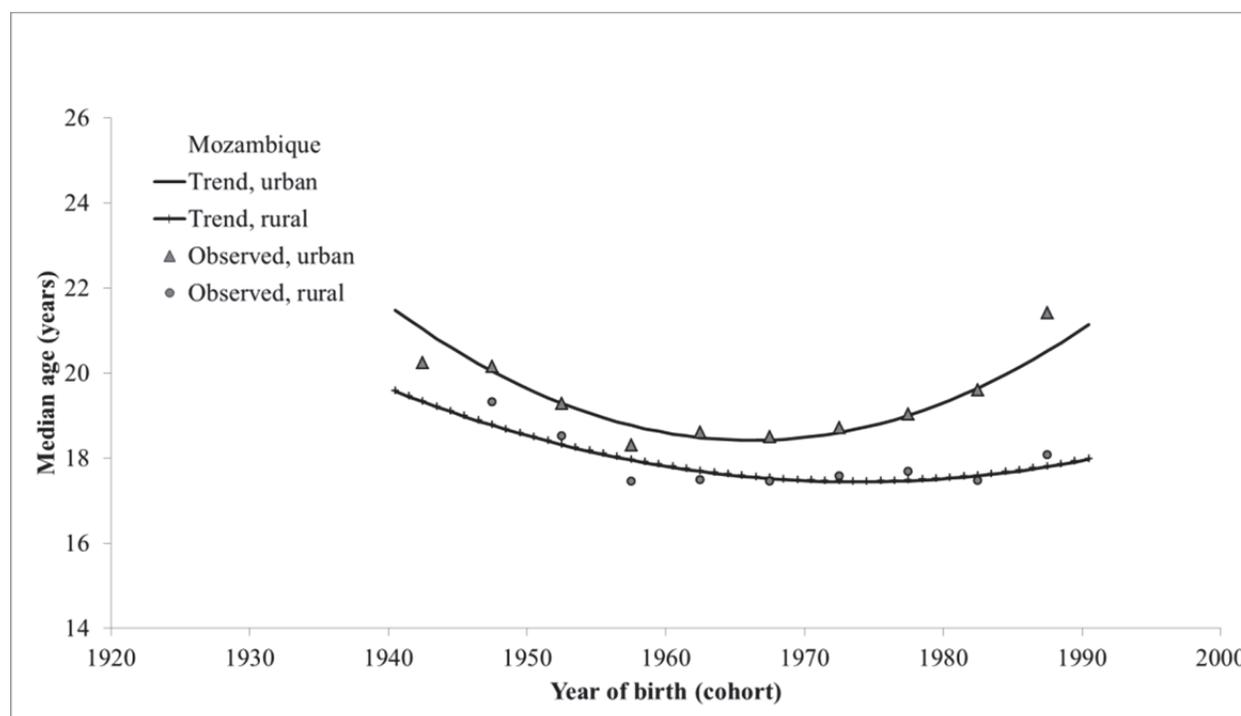
Table B-20.1. Survey characteristics, Mozambique

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1997 | 8,779 | 17.1 | 2.07 | 13.0 |
| DHS | 2003 | 12,418 | 17.5 | 2.48 | 47.4 |
| DHS | 2011 | 13,745 | 18.8 | 3.82 | |

Trends in age at marriage (Figure B-20.1)

Median age at first marriage was originally rather high in Mozambique but declined for cohorts born in 1940-1965. Then age at marriage increased in urban areas after 1965, and was little changed in rural areas.

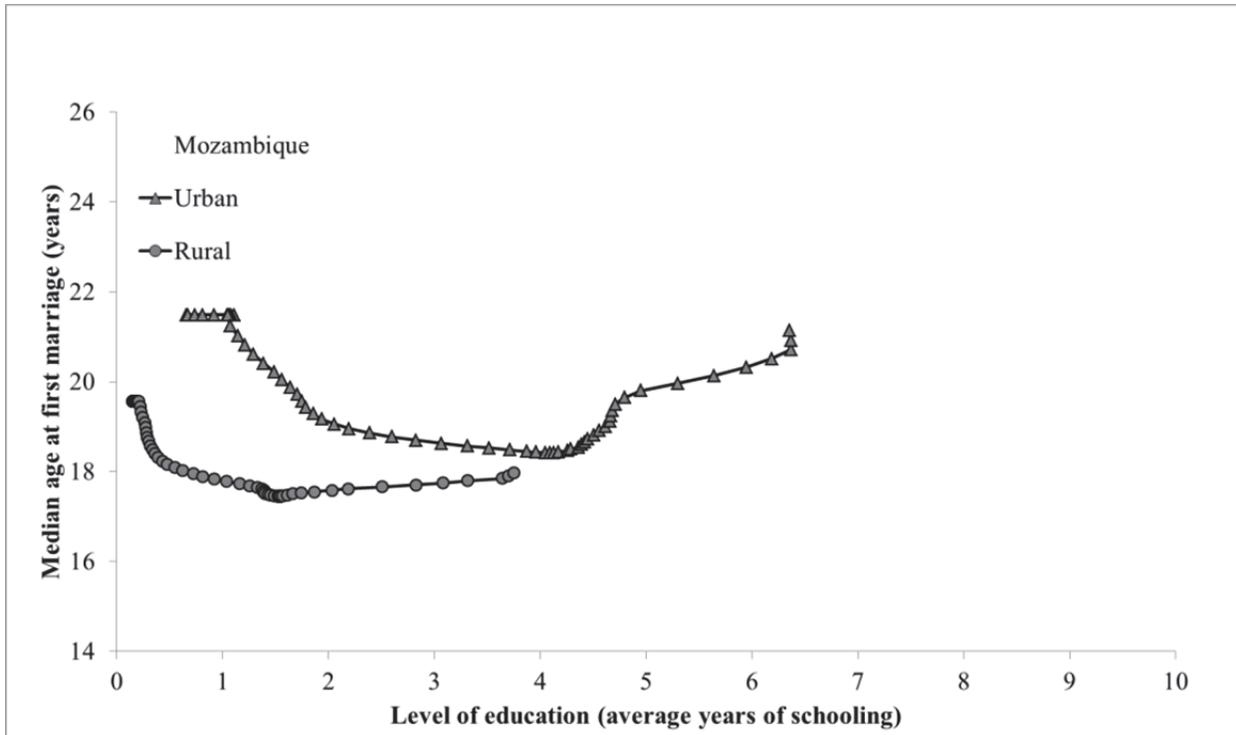
Figure B-20.1. Reconstructed trends in median age at first marriage, Mozambique



Relationship with education (Figure B-20.2)

As a result of the trends in age at marriage mentioned above, the relationship between trends in level of education and in age at marriage was inverse for the earlier cohorts, and as expected for the more recent cohorts. The pattern was further complicated by the rapid increase in education for the 1950-1960 cohorts, followed by stagnation later on.

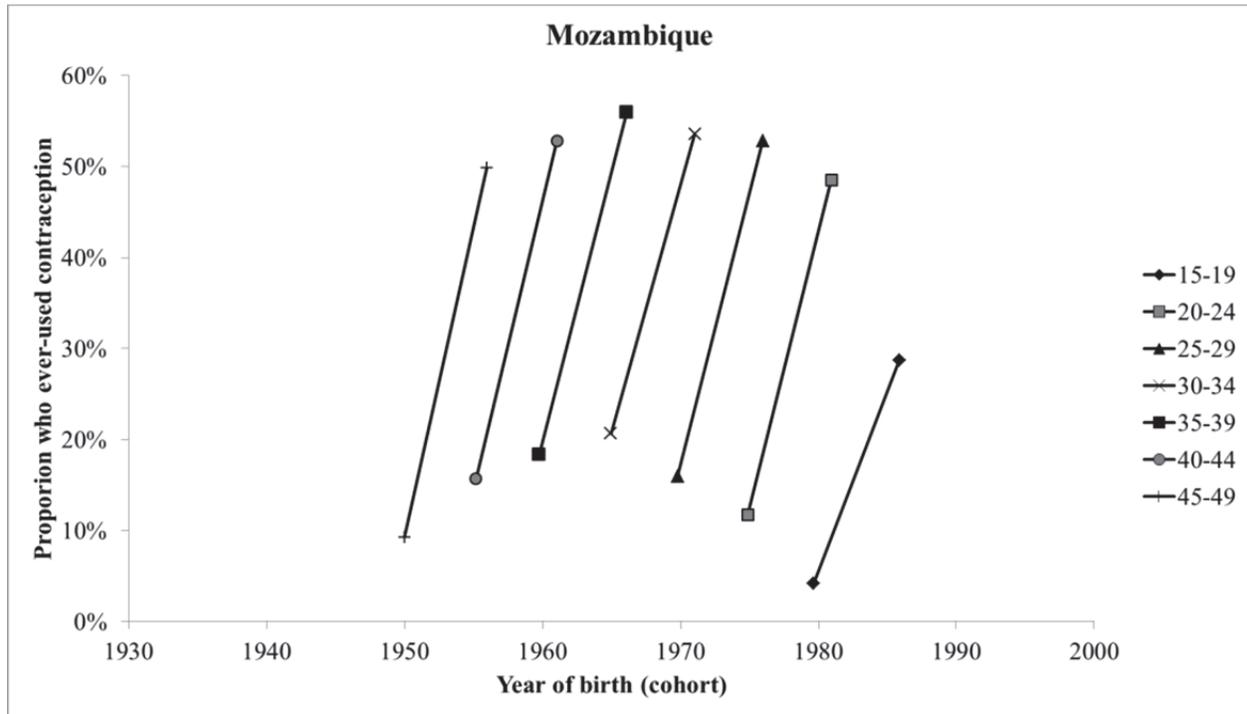
Figure B-20.2. Relationship between level of education and age at first marriage, Mozambique



Trends in contraceptive use (Figure B-20.3)

Trends in contraceptive use were straightforward and very marked in Mozambique, with a rapid increase between 1997 and 2003 affecting all cohorts and all ages.

Figure B-20.3. Trends in age-specific ever-use of contraception, Mozambique



21. Namibia

Three surveys were available in Namibia, conducted in 1992, 2000, and 2007. They were compatible for age at marriage, level of education, and ever-use of contraception.

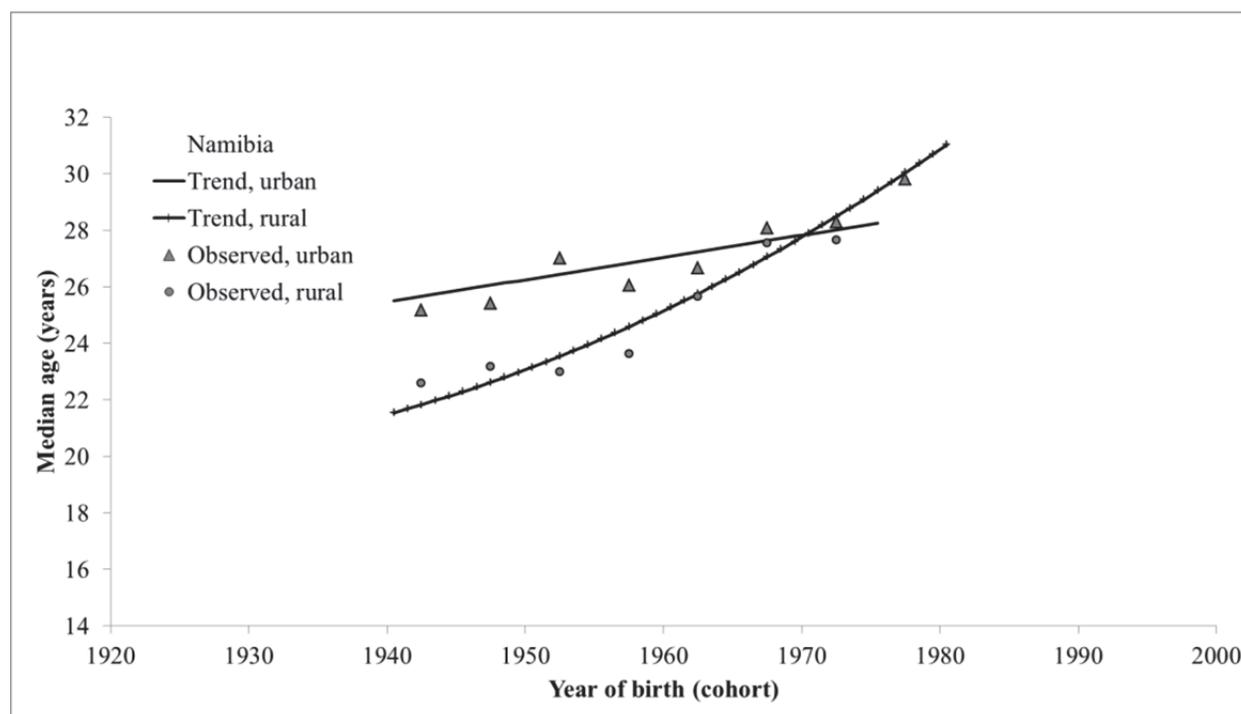
Table B-21.1. Survey characteristics, Namibia

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1992 | 5,421 | 24.8 | 5.89 | 37.1 |
| DHS | 2000 | 6,755 | 26.2 | 7.54 | 61.0 |
| DHS | 2007 | 9,804 | 29.1 | 8.41 | 70.5 |

Trends in age at marriage (Figure B-21.1)

Median age at first marriage was already high in Namibia for cohorts born in the 1940s, with a gap between urban and rural areas. Age at marriage continued to increase in urban areas, and was not available for the most recent cohorts because less than 50% were ever-married in 2007. In rural areas, median age at marriage increased rapidly, surpassed that of urban areas, and continued to increase up to the most recent cohort available. This pattern is unique in Africa, and it has led to a huge prevalence of premarital fertility documented elsewhere (Garenne and Zwang, 2006).

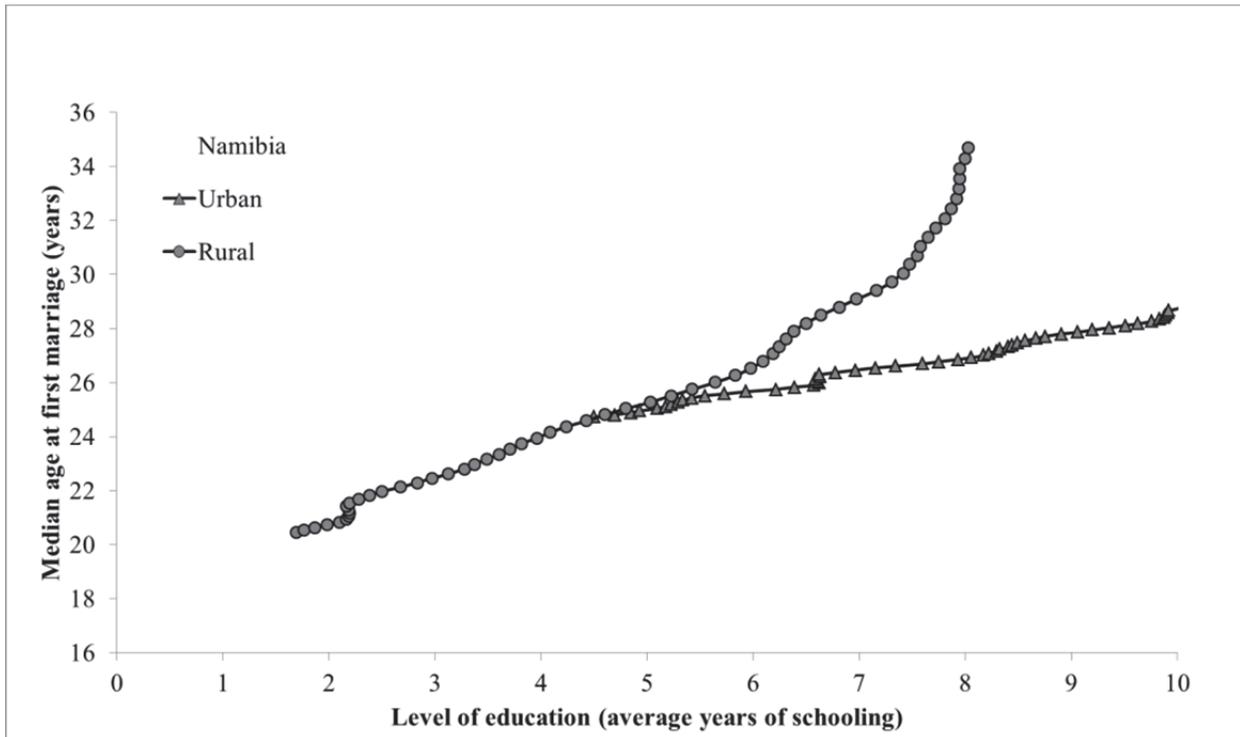
Figure B-21.1. Reconstructed trends in median age at first marriage, Namibia



Relationship with education (Figure B-21.2)

The relationship between trends in level of education and in age at marriage was straightforward in urban areas, and marked by the rapid increase in rural areas, documented above.

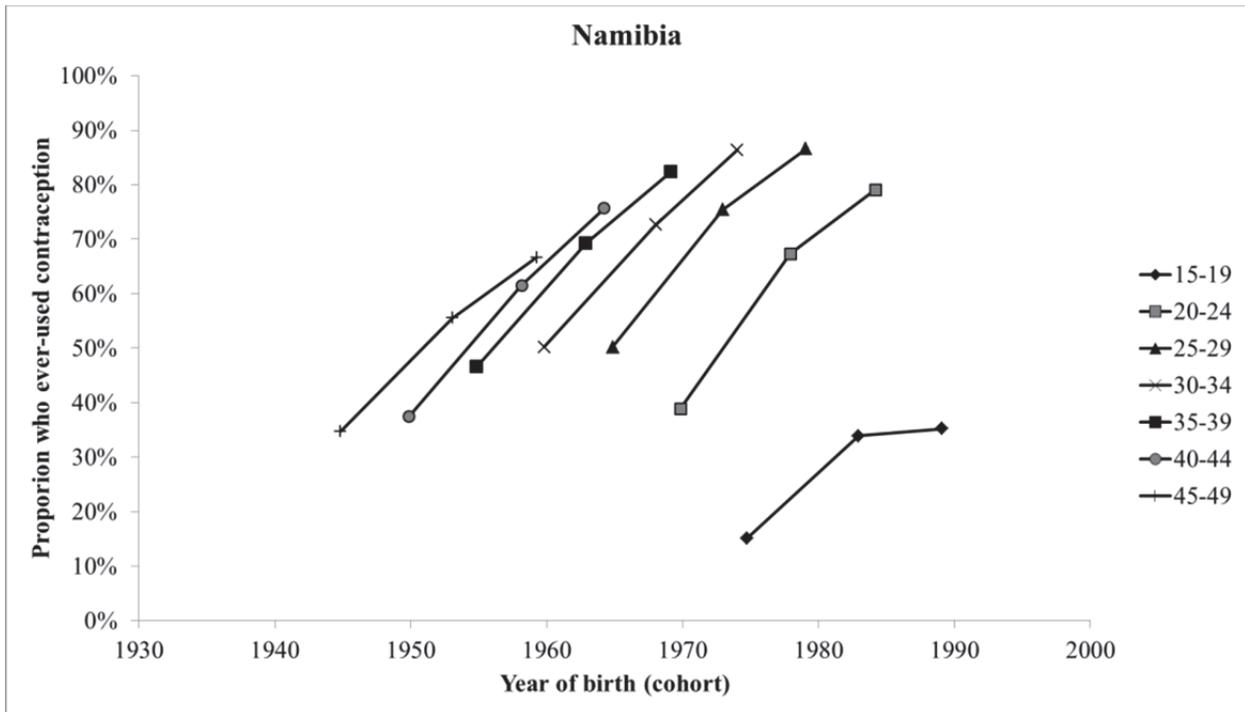
Figure B-21.2. Relationship between level of education and age at first marriage, Namibia



Trends in contraceptive use (Figure B-21.3)

Contraceptive use was already high for the older cohorts, and continued to increase steadily for all cohorts considered, reaching high values (> 80%) for the mid-age cohorts. Only the 15-19 age group stands out with a lower proportion of women who ever-used contraception.

Figure B-21.3. Trends in age-specific ever-use of contraception, Namibia



22. Niger

Three surveys were available in Niger, conducted in 1992, 1997, and 2006. They were all compatible with respect to the three variables investigated. Age at marriage, level of education, and ever-use of contraception all were at low levels, with stagnation in ever-use of contraception in the 2006 survey compared with the 1997 survey.

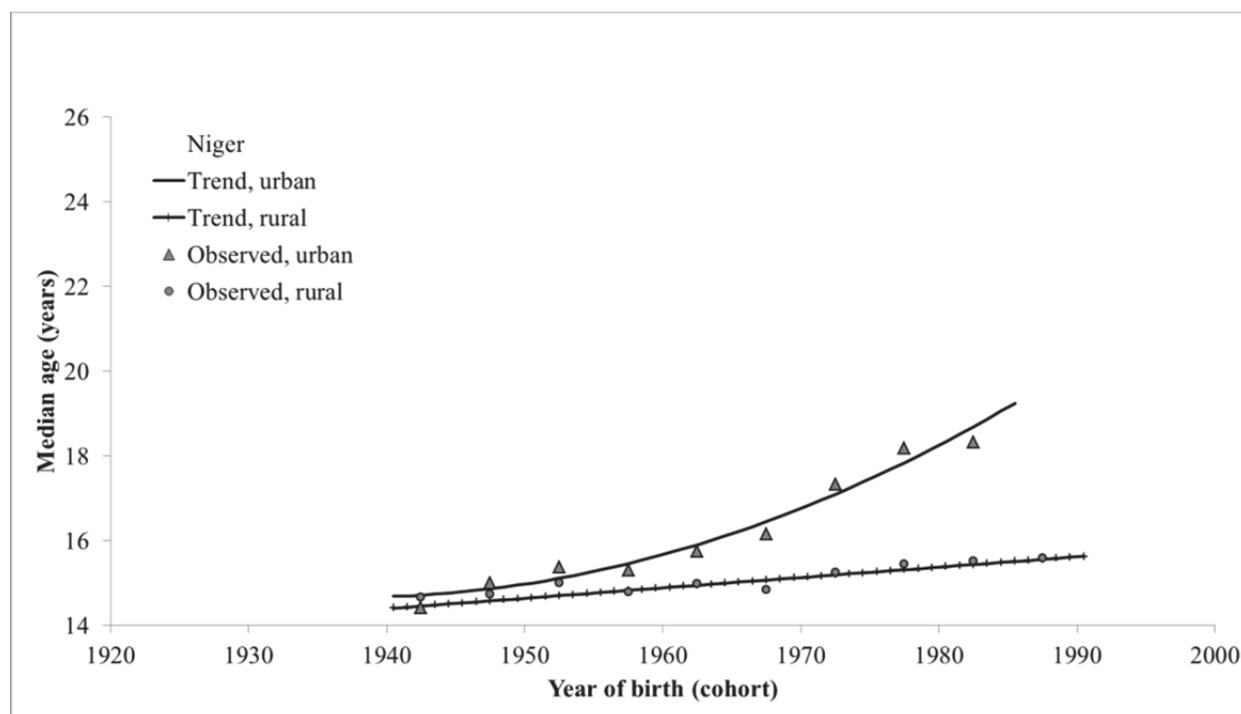
Table B-22.1. Survey characteristics, Niger

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1992 | 6,503 | 14.9 | 0.57 | 4.4 |
| DHS | 1997 | 7,577 | 15.1 | 0.97 | 10.9 |
| DHS | 2006 | 9,223 | 15.5 | 0.99 | 10.9 |

Trends in age at marriage (Figure B-22.1)

Median age at first marriage was very low in Niger for cohorts born in the 1940s, with hardly any difference between urban and rural areas. In urban areas, it increased steadily over the years, while remaining low in rural areas, although with a significant positive slope.

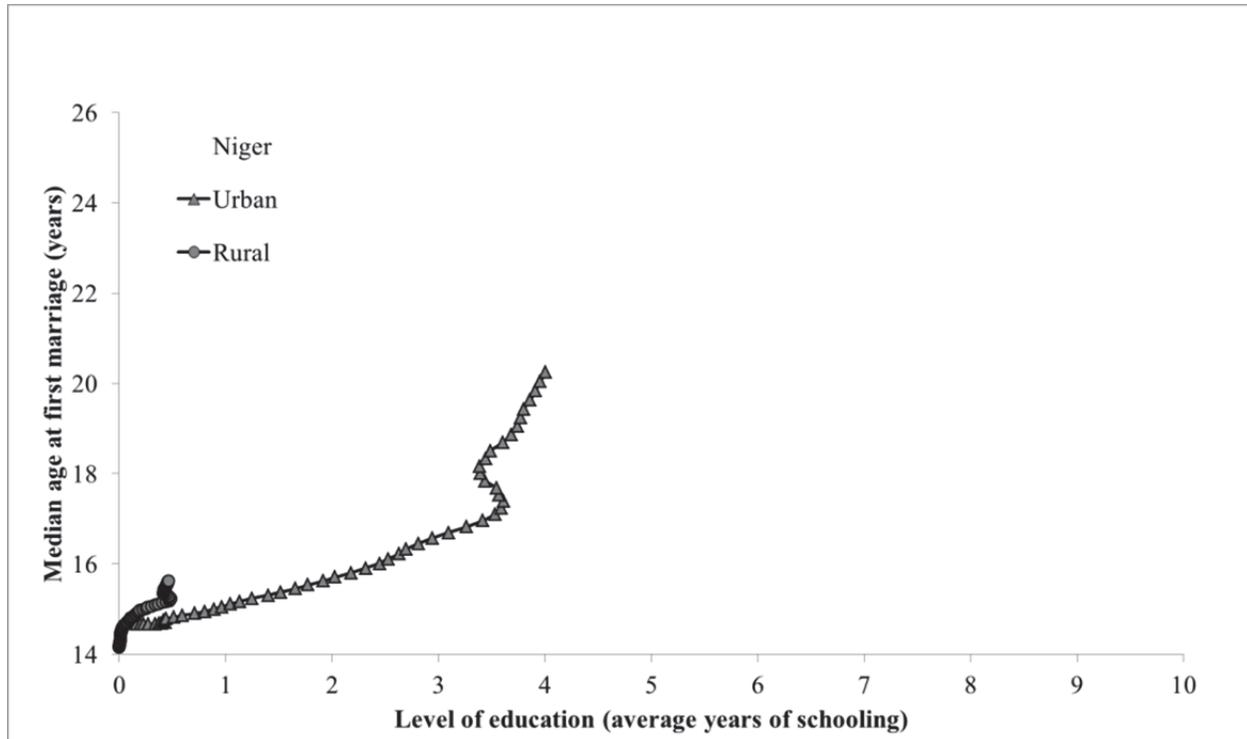
Figure B-22.1. Reconstructed trends in median age at first marriage, Niger



Relationship with education (Figure B-22.2)

The relationship between trends in level of education and in age at marriage was hardly visible in rural areas, because of the low level of education. In urban areas it followed a regular pattern up to cohorts born in 1973; then age at marriage continued to increase despite stagnation, and even a regression, in the level of education.

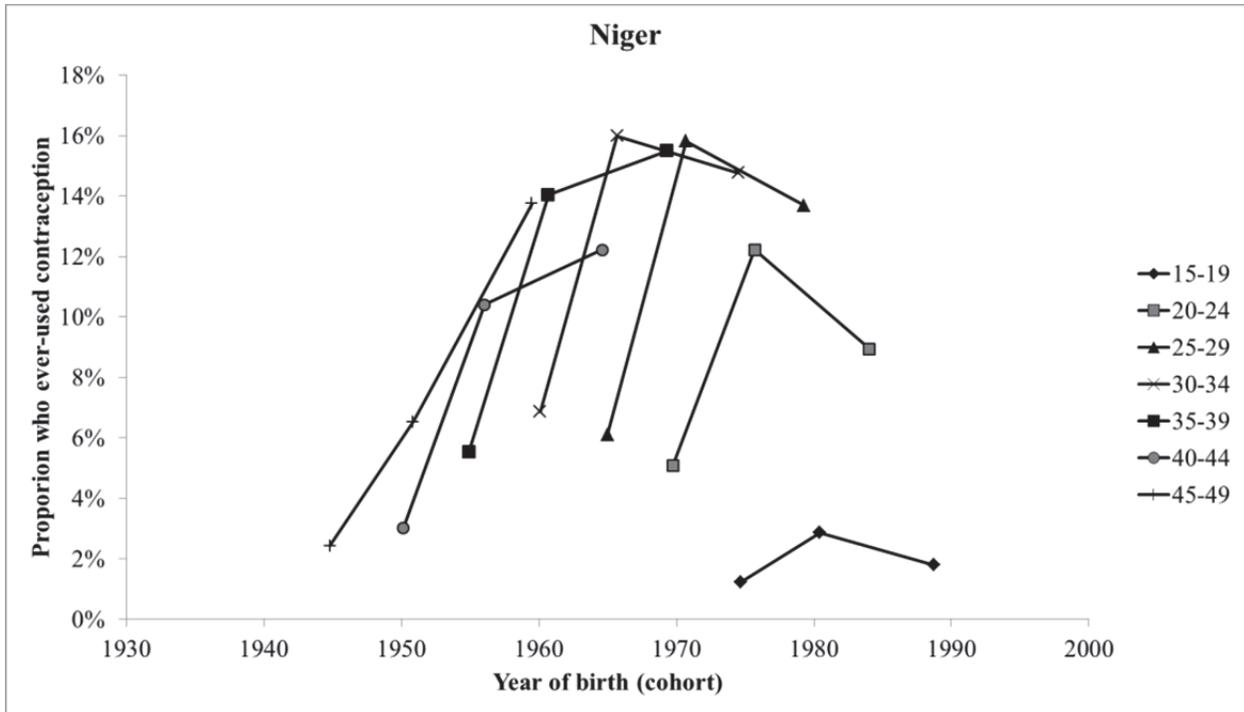
Figure B-22.2. Relationship between level of education and age at first marriage, Niger



Trends in contraceptive use (Figure B-22.3)

Contraceptive use increased steadily for all cohorts until the 2006 survey. In the 2006 survey, however, for women under age 35, the proportion who ever-used contraception stagnated or even regressed, suggesting a problem with data. This was not the case for older women, age 35-49, among whom ever-use continued to increase.

Figure B-22.3. Trends in age-specific ever-use of contraception, Niger



23. Nigeria

Five surveys were available in Nigeria, starting with the 1982 WFS, followed by DHS surveys conducted in 1990, 1999, 2003, and 2008. Overall, the surveys were compatible with respect to the three variables investigated, although the 1999 survey, known to have some data problems, seems to have over-estimated age at marriage, while the 2003 survey seems to have under-estimated age at marriage.

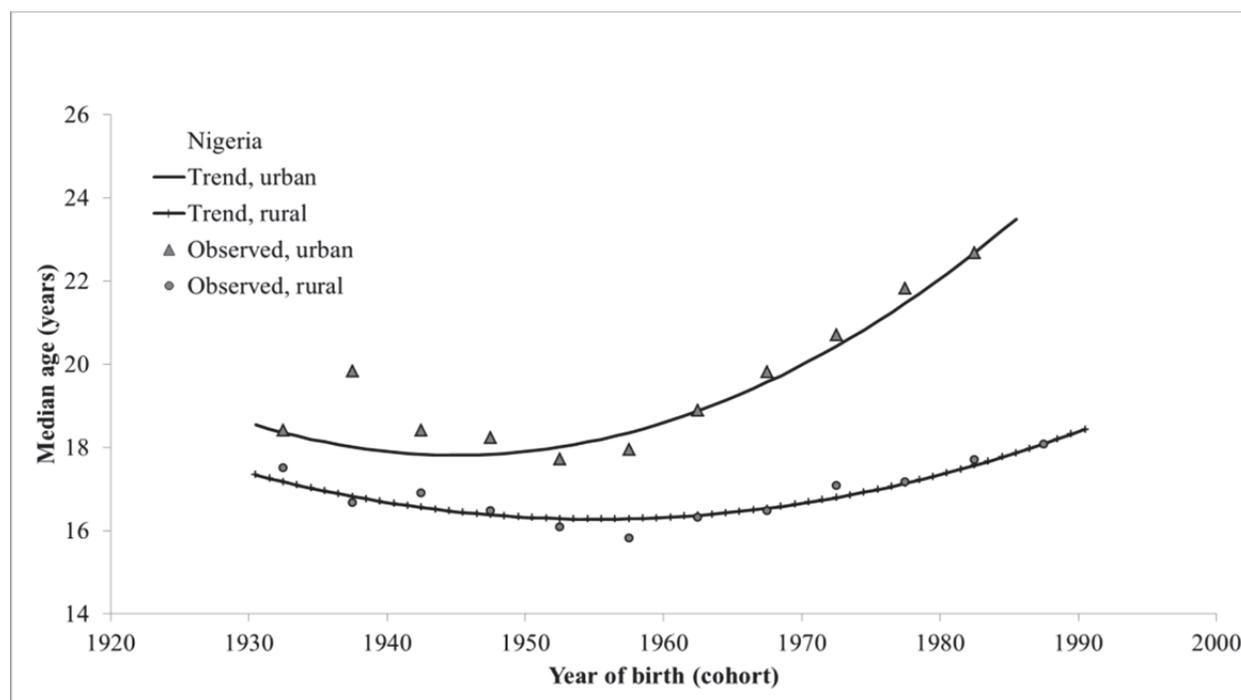
Table B-23.1. Survey characteristics, Nigeria

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1982 | 9,727 | 16.3 | 2.48 | 2.6 |
| DHS | 1990 | 8,781 | 16.9 | 3.13 | 9.0 |
| DHS | 1999 | 9,810 | 17.9 | 4.97 | 17.8 |
| DHS | 2003 | 7,620 | 16.6 | 5.10 | 22.7 |
| DHS | 2008 | 33,385 | 18.3 | 6.10 | 24.0 |

Trends in age at marriage (Figure B-23.1)

Median age at first marriage was average in Nigeria for cohorts born in the 1930s, with a small difference between urban and rural areas, and a small declining trend. It increased markedly in urban areas for cohorts born after 1960, while increasing only slowly in rural areas.

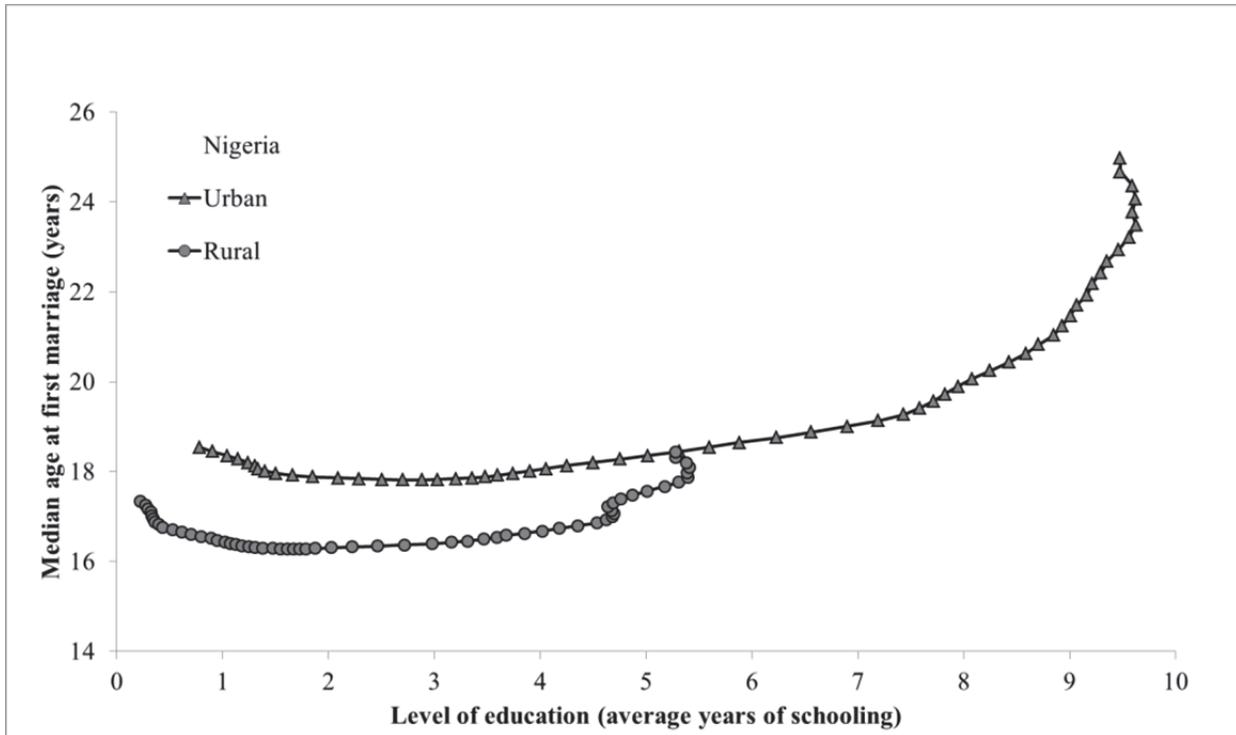
Figure B-23.1. Reconstructed trends in median age at first marriage, Nigeria



Relationship with education (Figure B-23.2)

The relationship between trends in level of education and in age at marriage was not linear. For the older cohorts, it was reversed (declining age at marriage despite increasing level of education), then it was flat for a long time, to increase rapidly thereafter, and becoming almost vertical for the recent cohorts, when age at marriage continued to rise while level of education stagnated.

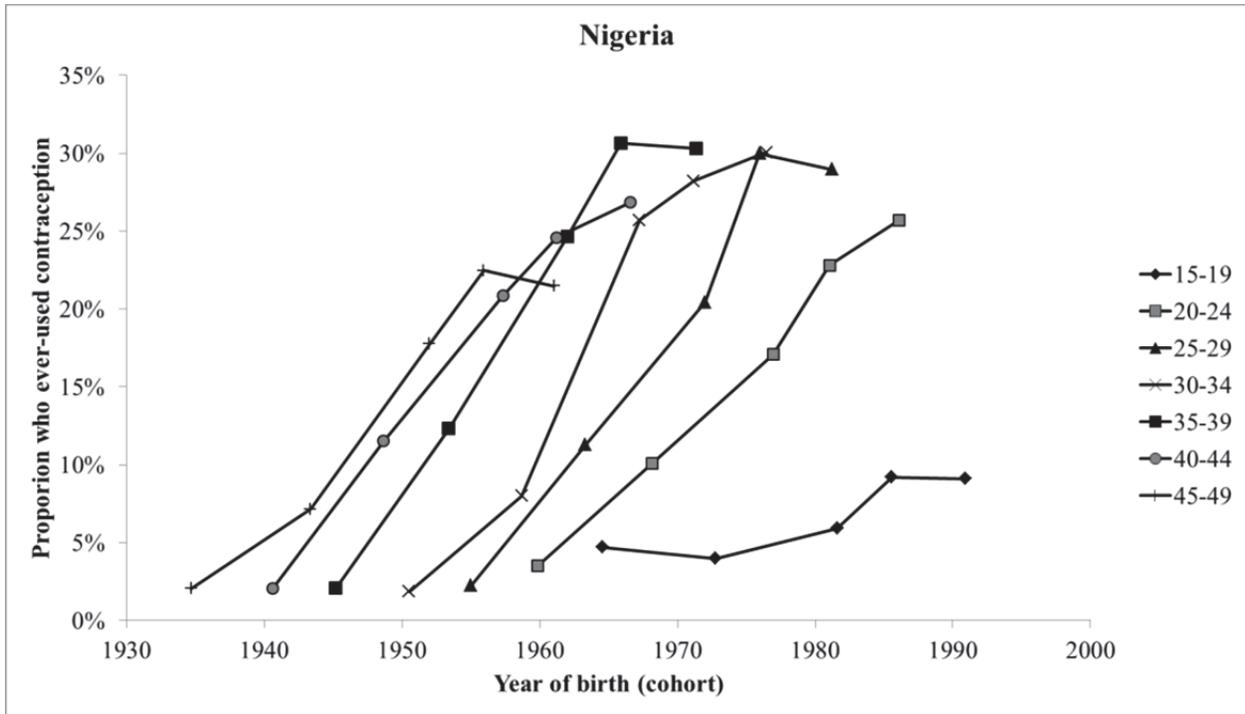
Figure B-23.2. Relationship between level of education and age at first marriage, Nigeria



Trends in contraceptive use (Figure B-23.3)

Contraceptive use increased steadily for cohorts until the 2008 survey, when the proportion of women who ever-used contraception appeared to stagnate or decline for women age 45-49, 25-39, and 30-34, indicating a mild problem with data. The 15-19 age groups showed a much lower level of ever-use of contraception.

Figure B-23.3. Trends in age-specific ever-use of contraception, Nigeria



24. Rwanda

Five surveys were available in Rwanda, starting with the 1983 WFS, followed by the 1992, 2000, 2005 and 2011 DHS surveys. Overall, the surveys were compatible for age at marriage and level of education, while apparently inconsistent for ever-use of contraception. However, the 2011 survey did not provide information on ever-use of contraception. Rwanda underwent an extremely difficult period during the civil war in the 1990s.

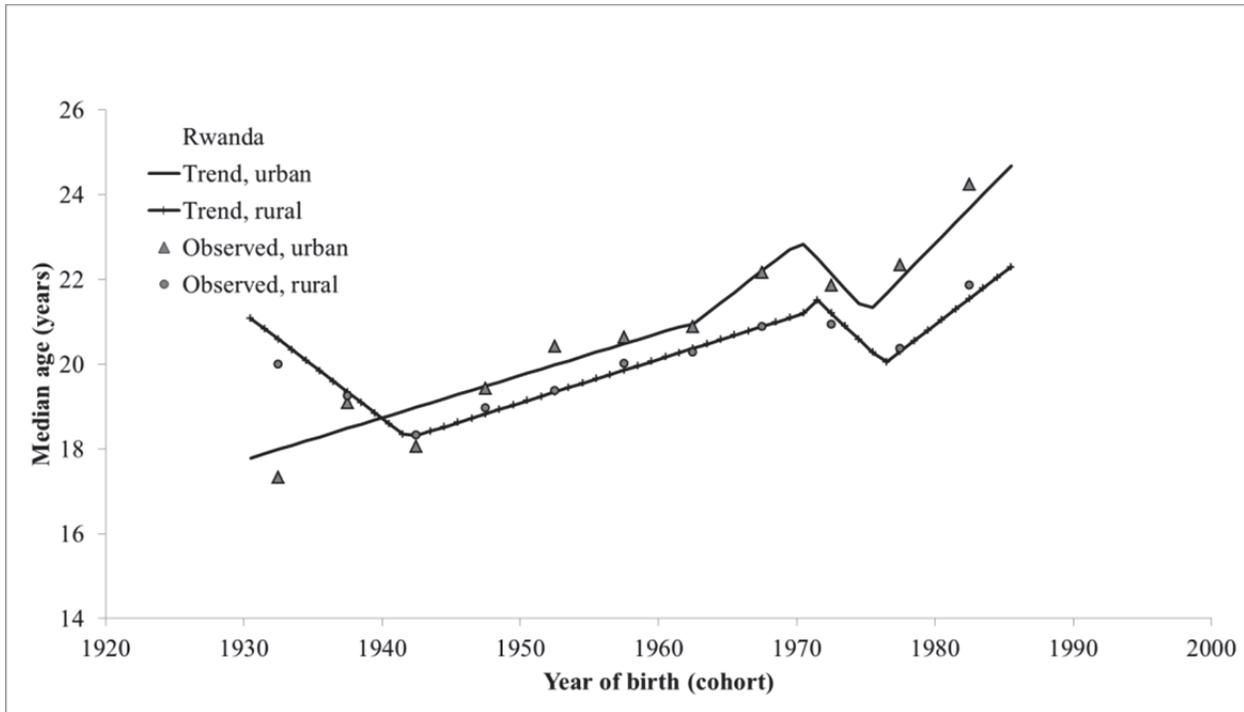
Table B-24.1. Survey characteristics, Rwanda

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1983 | 5,738 | 19.1 | 1.92 | 1.5 |
| DHS | 1992 | 6,551 | 20.0 | 3.40 | 16.8 |
| DHS | 2000 | 10,421 | 20.7 | 3.71 | 15.5 |
| DHS | 2005 | 11,321 | 20.7 | 3.75 | 15.2 |
| DHS | 2011 | 13,671 | 21.4 | 4.40 | |

Trends in age at marriage (Figure B-24.1)

Median age at first marriage was average in Rwanda for cohorts born in the 1940s, with hardly any difference between urban and rural areas. Both urban and rural areas experienced a rise in age at marriage for cohorts 1940-1965, followed by a drop for cohorts reaching adulthood in the 1990s, then followed by a new rise for cohorts born after 1975.

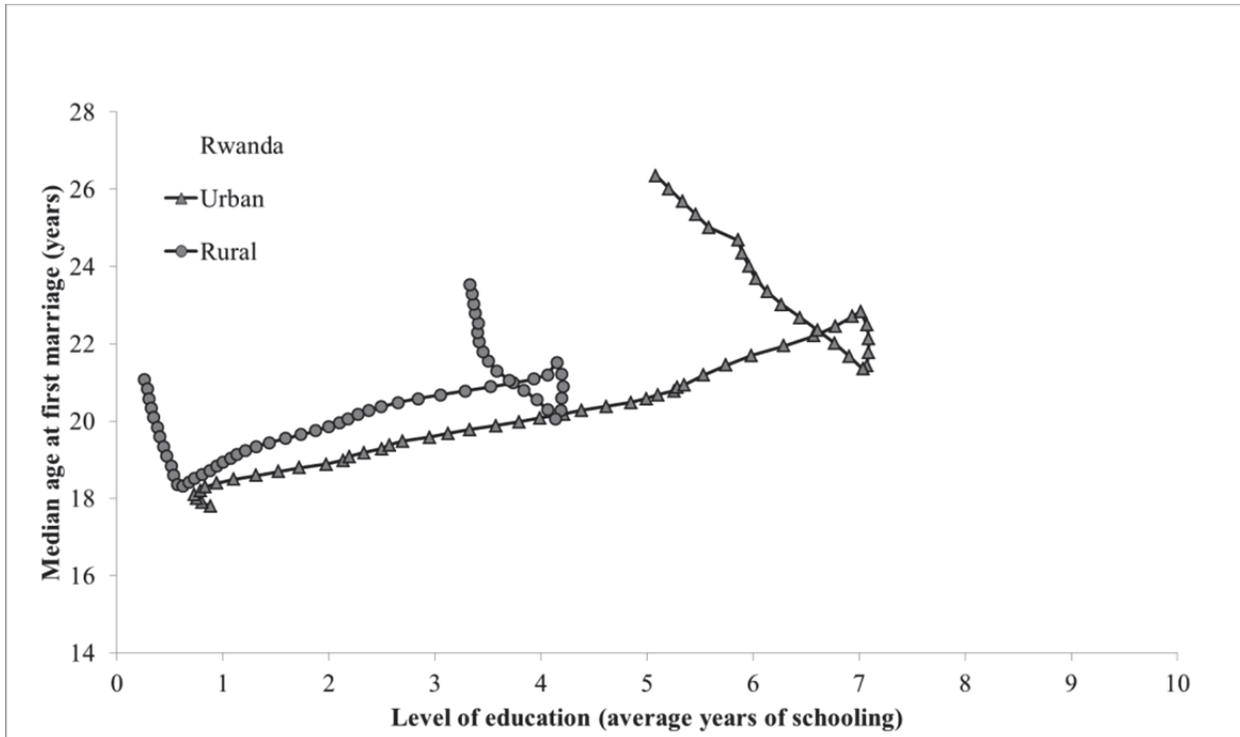
Figure B-24.1. Reconstructed trends in median age at first marriage, Rwanda



Relationship with education (Figure B-24.2)

The relationship between trends in level of education and in age at marriage was particularly complex in Rwanda, due to changes in both level of education and age at marriage associated with the difficult years of the civil war. Both urban and rural areas followed the same pattern of showing, first, a positive relationship, then a loop during the crisis years, and finally a negative relationship corresponding to the declining level of education.

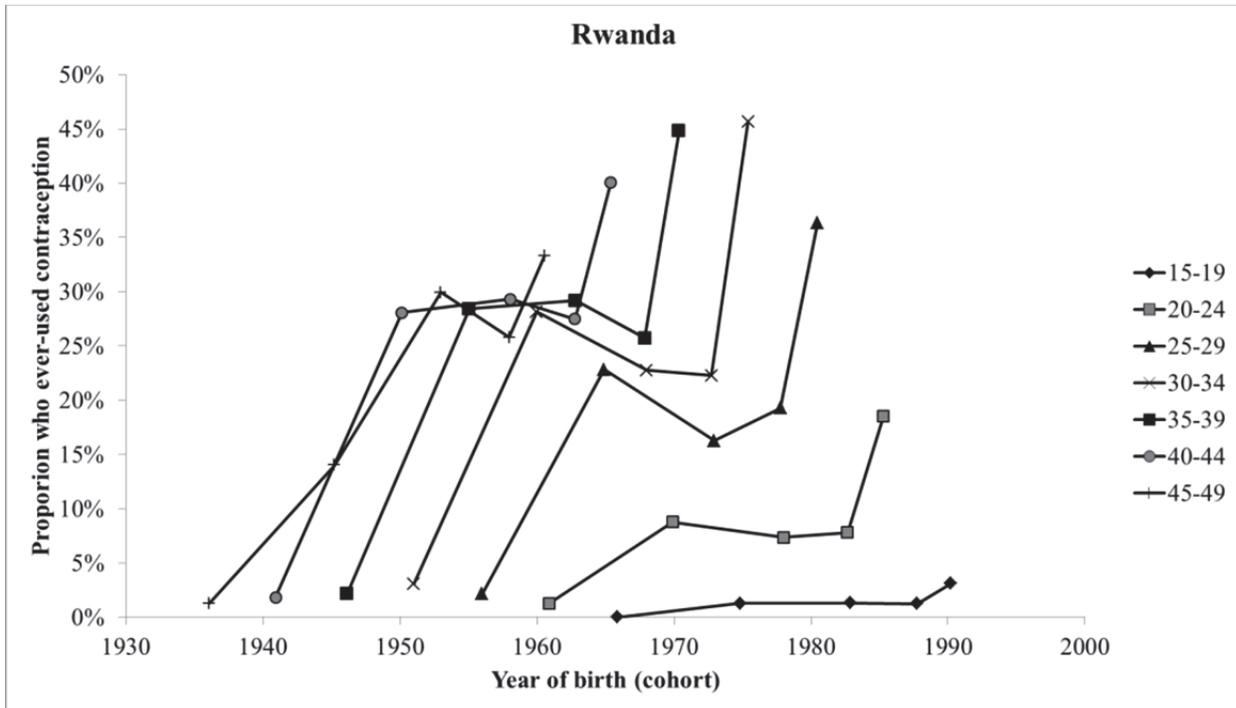
Figure B-24.2. Relationship between level of education and age at first marriage, Rwanda



Trends in contraceptive use (Figure B-24.3)

Contraceptive use showed a strange pattern, with an abnormal rise and fall. The second survey (1992) might have over-estimated the level of contraceptive use. The later stagnation makes sense, since it occurred mostly during the crisis years. At last survey however, the proportion of women who ever-used contraception increased markedly, and seems to have recovered from earlier trends. Population dynamics were so complex over this period, with mass killing and large international migration flows, that empirical findings are difficult to interpret due to numerous possible selection biases.

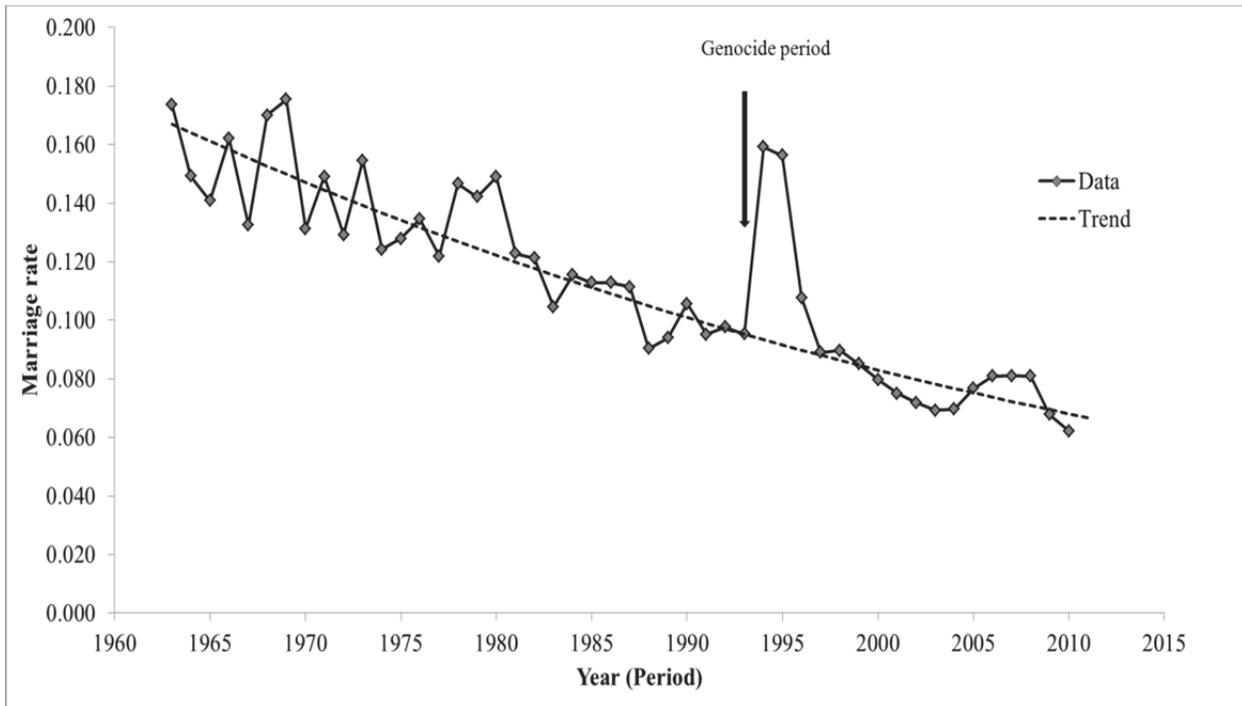
Figure B-24.3. Trends in age-specific ever-use of contraception, Rwanda



Short term changes during the crisis years (1994-1995)

During the two years following the genocide, marriage rates computed as the number of first marriages by the person-years lived by never-married women age 14-29, had a major increase compared with trends before and after. This effect deserves more research. (Figure 24.4)

Figure B-24.4. Trends in period first marriage rates, women age 14-29, Rwanda



25. Senegal

Six surveys were available in Senegal, starting with the 1978 WFS, followed by five DHS surveys conducted in 1986, 1993, 1997, 2005 and 2011. Overall, the surveys were compatible for the three variables investigated, with some mild inconstancy for age at marriage in 1993. The 2011 DHS did not provide information on ever-use of contraception.

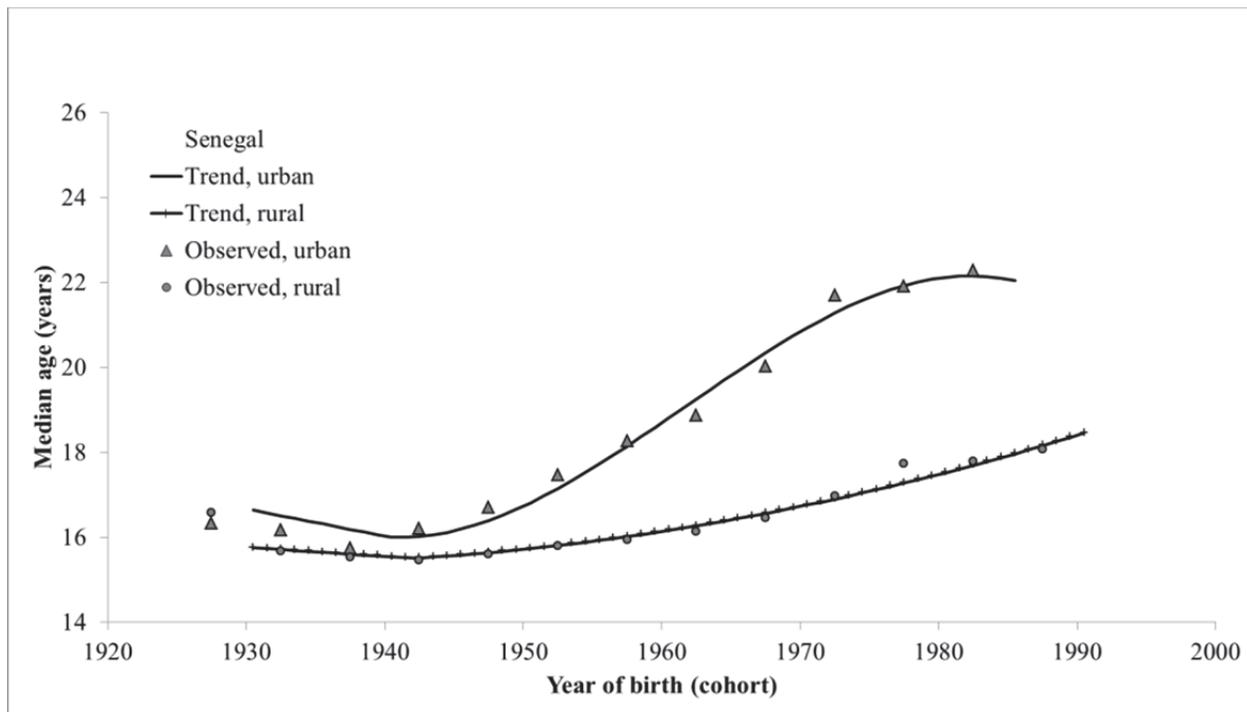
Table B-25.1. Survey characteristics, Senegal

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| WFS | 1978 | 3,985 | 15.8 | 0.95 | 1.3 |
| DHS | 1986 | 4,415 | 16.4 | 1.78 | 6.2 |
| DHS | 1993 | 6,310 | 16.2 | 1.81 | 10.2 |
| DHS | 1997 | 8,593 | 17.4 | 2.31 | 14.8 |
| DHS | 2005 | 14,602 | 18.3 | 2.69 | 19.9 |
| DHS | 2011 | 15,688 | 19.3 | 2.94 | |

Trends in age at marriage (Figure B-25.1)

Median age at first marriage was low in Senegal for cohorts born in the 1930s, with a small difference between urban and rural areas, and a small declining trend. It increased in urban areas for cohorts born after 1945, and somewhat later in rural areas, but stagnated in urban areas for the more recent cohorts.

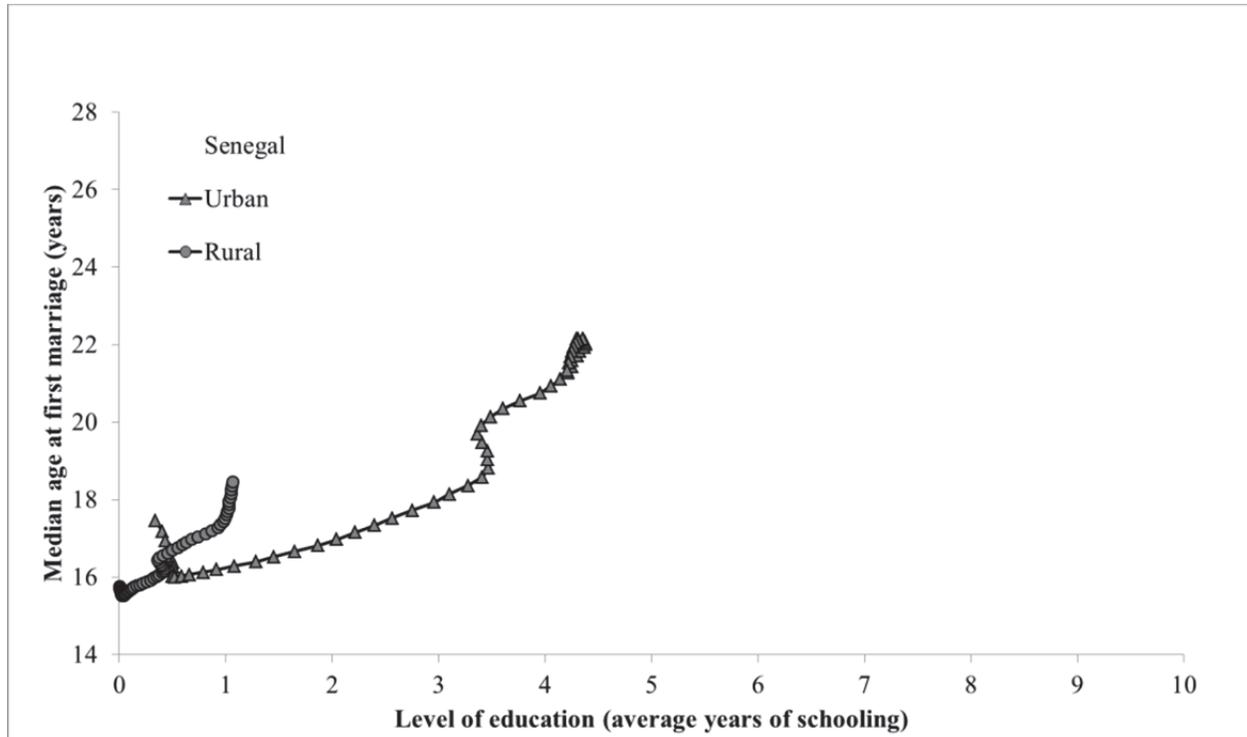
Figure B-25.1. Reconstructed trends in median age at first marriage, Senegal



Relationship with education (Figure B-25.2)

The relationship between trends in level of education and in age at marriage was not linear. The change in trends in urban areas was due to stagnation in level of education for cohorts 1955-1965, and cohorts 1975-1985, while age at marriage continued to increase. In the most recent cohorts, both age at marriage and level of education stagnated. In rural areas level of education even reversed, while age at marriage increased somewhat.

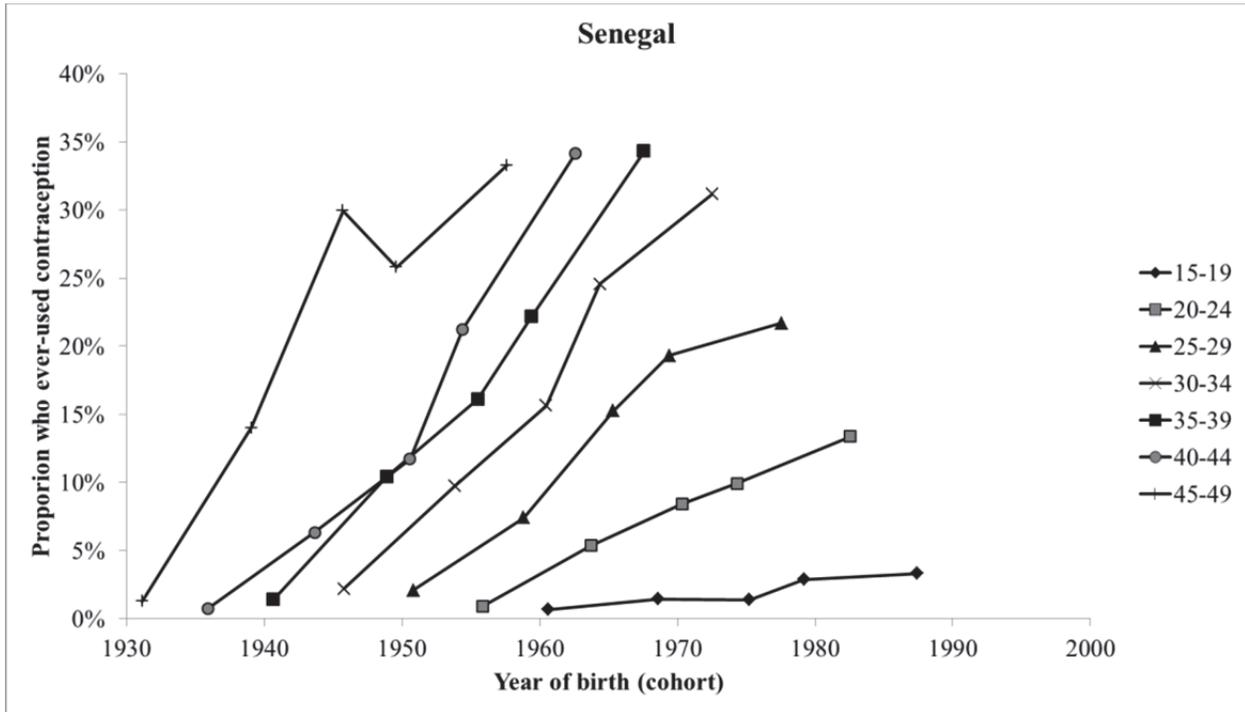
Figure B-25.2. Relationship between level of education and age at first marriage, Senegal



Trends in contraceptive use (Figure B-25.3)

In contrast, ever-use of contraception increased steadily for all cohorts considered. The minor erratic patterns seen at age 45-49 and 40-44 seem due to small sample size. The mid-age women reached a medium level (around 35%), while contraceptive use remained low for women age 15-19.

Figure B-25.3. Trends in age-specific ever-use of contraception, Senegal



26. Sierra Leone

Only one survey is available in Sierra Leone. The country underwent a troubled period during the civil war in the late 1980s and early 1990s.

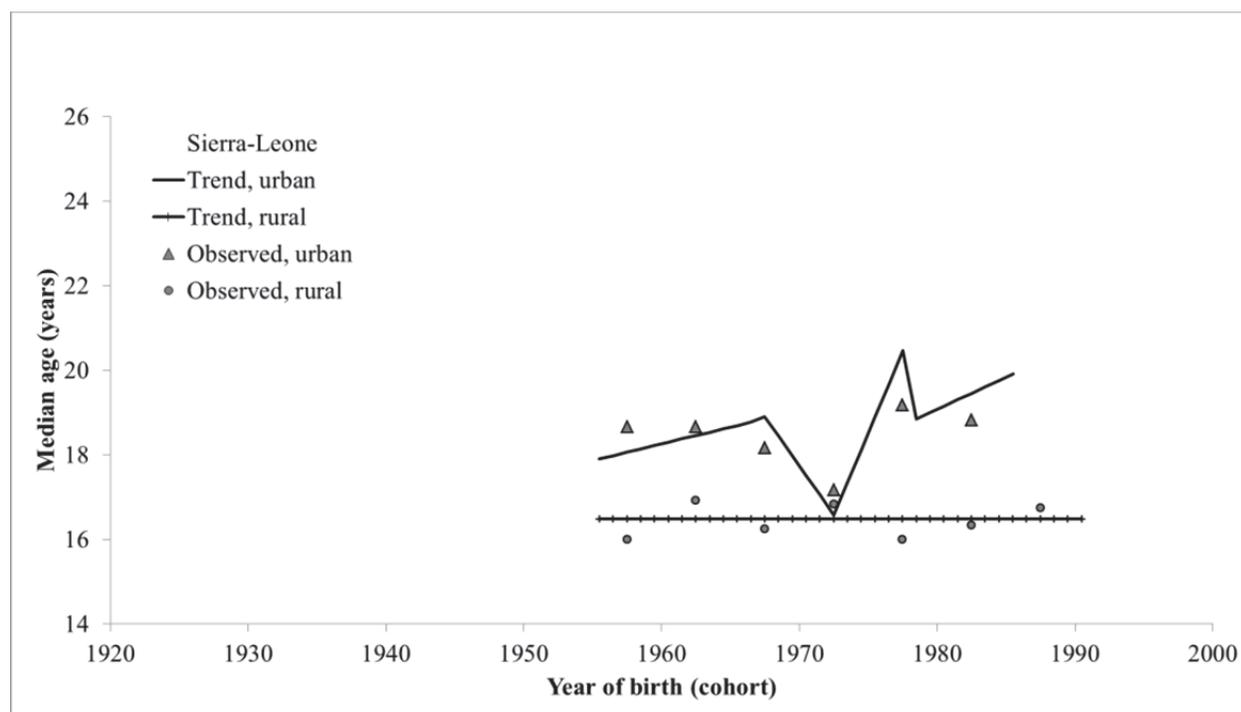
Table B-26.1. Survey characteristics, Sierra Leone

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 2008 | 7,374 | 17.0 | 2.56 | 20.5 |

Trends in age at marriage (Figure B-26.1)

Median age at first marriage was low in Sierra Leone for cohorts born in the late 1950s, with a small difference between urban and rural areas. Age at marriage dropped, then increased in urban areas, corresponding to the civil war period, while it remained constant at a low level in rural areas.

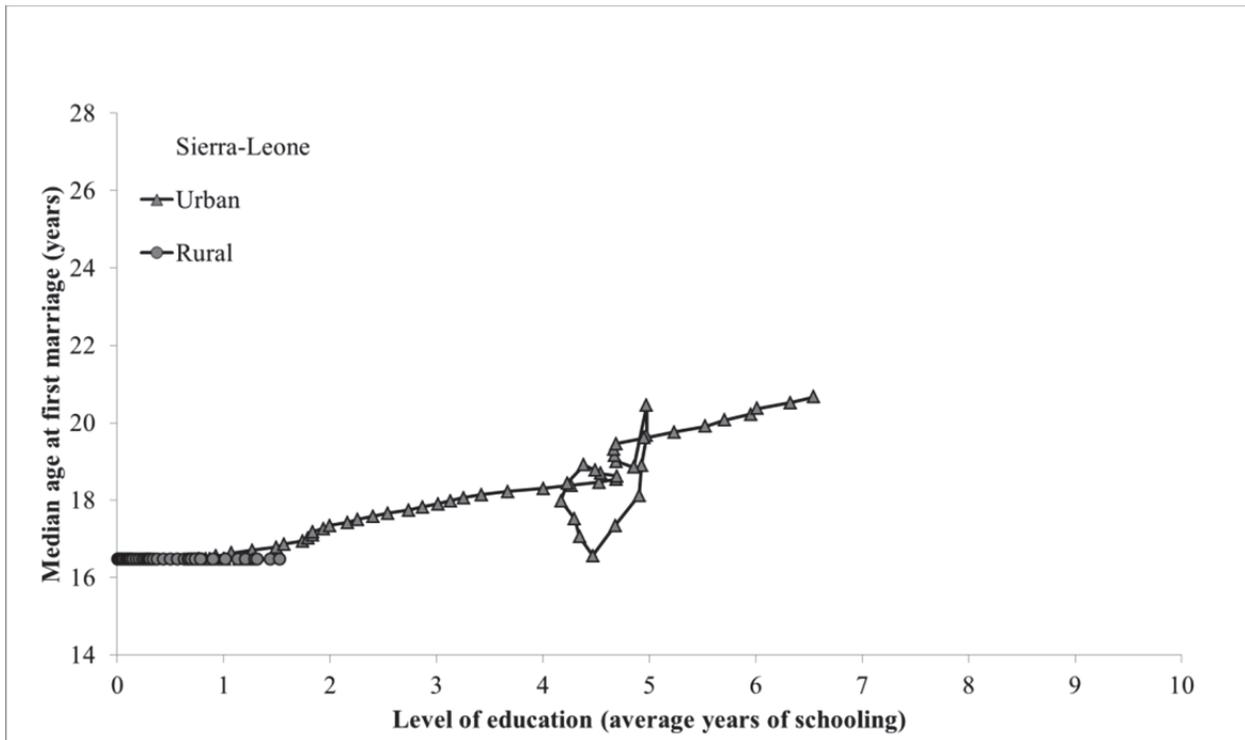
Figure B-26.1. Reconstructed trends in median age at first marriage, Sierra Leone



Relationship with education (Figure B-26.2)

The relationship between trends in level of education and in age at marriage would be linear except for a loop during the civil war years. Age at marriage remained constant in rural areas despite some mild rise in level of education.

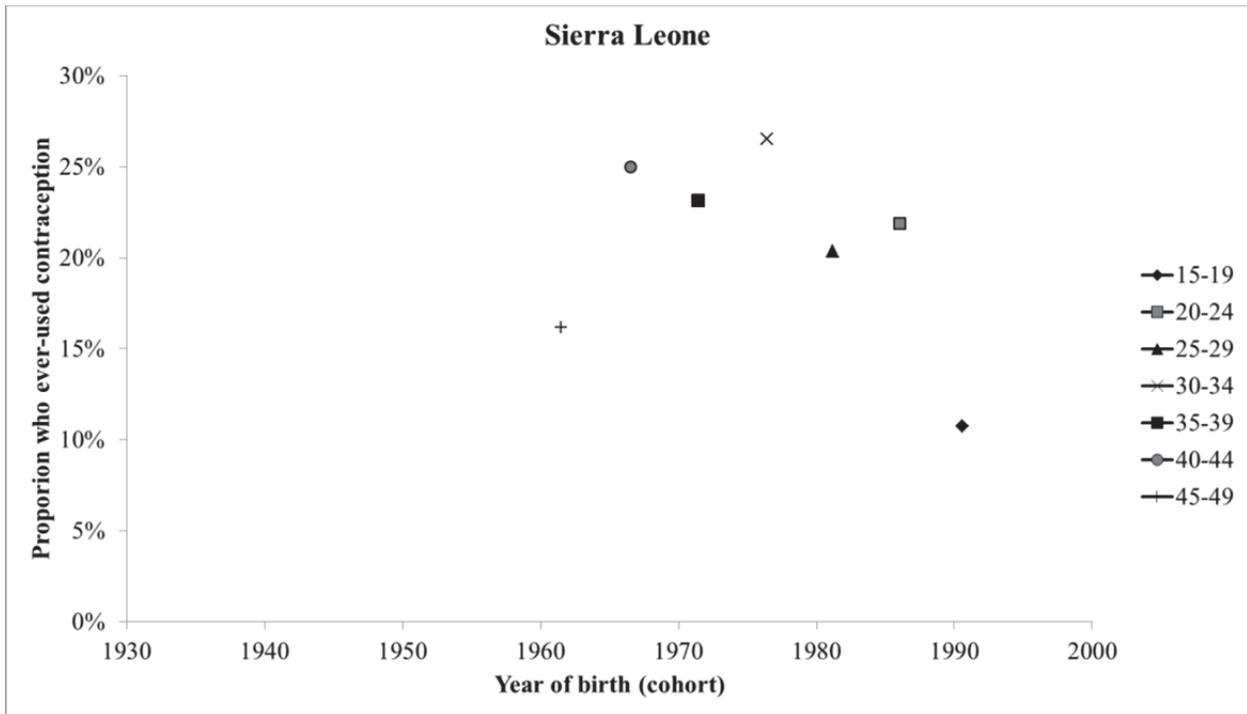
Figure B-26.2. Relationship between level of education and age at first marriage, Sierra Leone



Trends in contraceptive use (Figure B-26.3)

Contraceptive use at the 2008 survey showed a rising cohort trend and the expected trend by age. Ever-use increased with some irregularities in the 40-44 age group (cohort trend) and in the 20-24 age group (age pattern).

Figure B-26.3. Trends in age-specific ever-use of contraception, Sierra Leone



27. South Africa

Only one DHS survey, conducted in 1998, was available in South Africa, which seriously limits the analysis. Compared with other African countries, South Africa is more advanced, with higher levels of income, levels of education, age at marriage, and contraceptive prevalence.

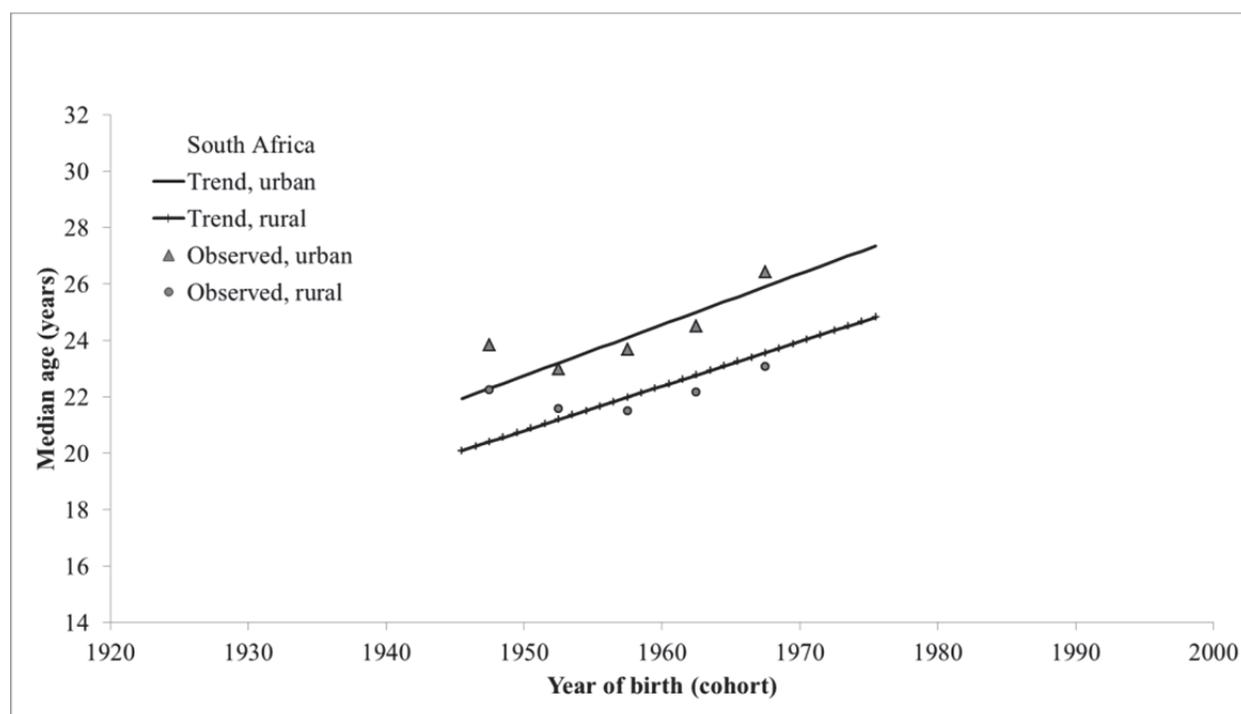
Table B-27.1. Survey characteristics, South Africa

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1998 | 11,735 | 24.2 | 8.65 | 73.9 |

Trends in age at marriage (Figure B-27.1)

Median age at first marriage was high in South Africa, and steadily increasing in both urban and rural areas for the available cohorts.

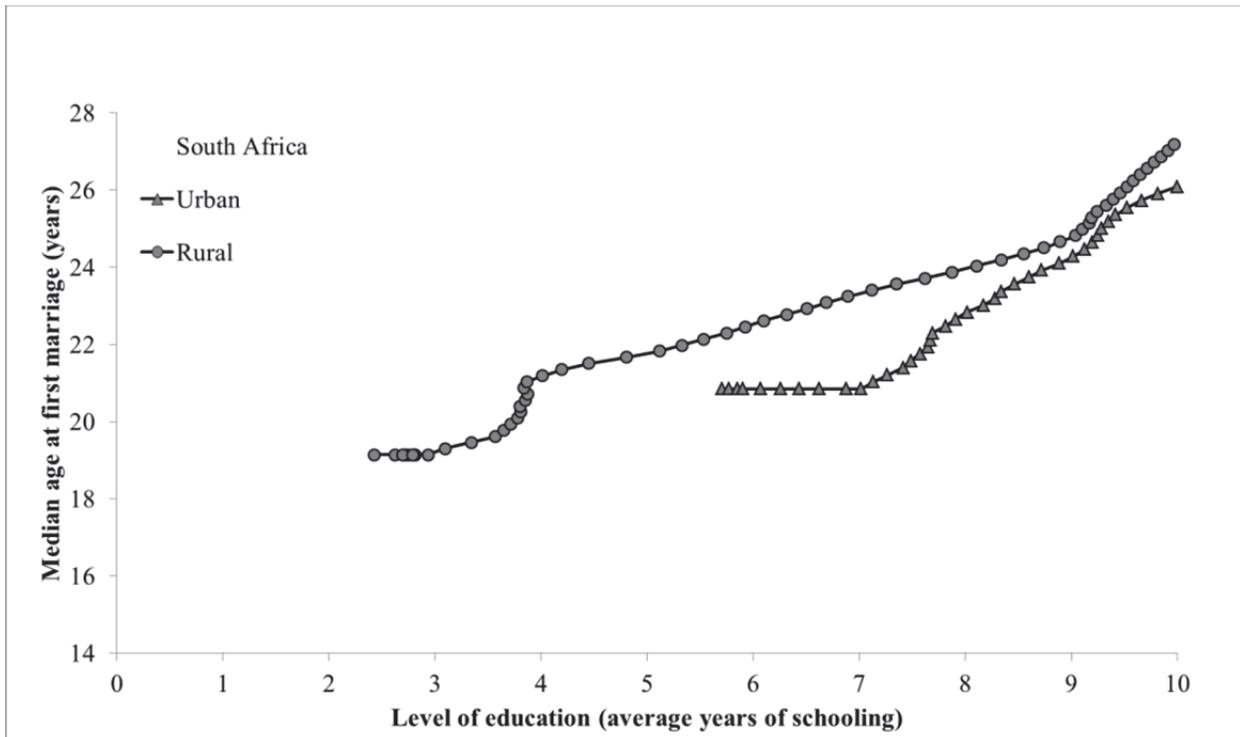
Figure B-27.1. Reconstructed trends in median age at first marriage, South Africa



Relationship with education (Figure B-27.2)

Because level of education increased steadily for cohorts born after 1925, the relationship between trends in level of education and in age at marriage was monotonic, and almost linear, with some stagnation in the older cohorts and some acceleration in the younger cohorts.

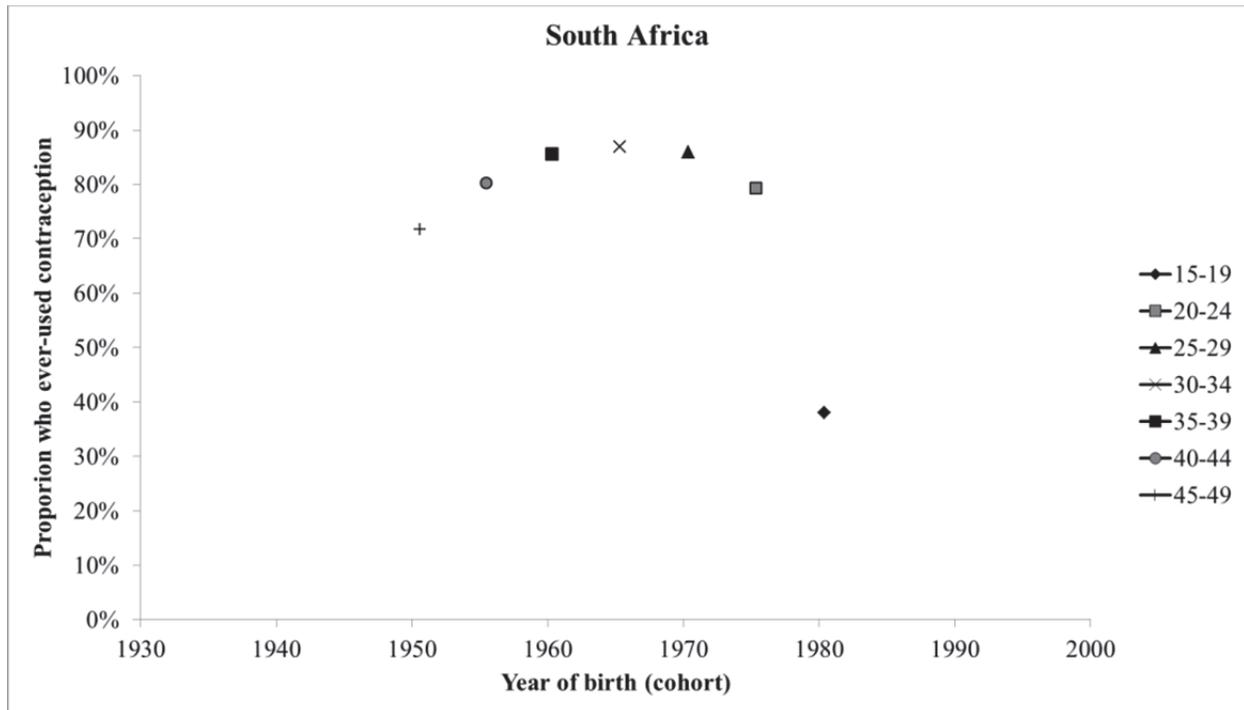
Figure B-27.2. Relationship between level of education and age at first marriage, South Africa



Trends in contraceptive use (Figure B-27.3)

Ever-use of contraception was very high for the 1950-1975 cohorts, reaching almost 90% for women age 30-34, with a mild cohort trend. The age effect was small, with only a relatively small level of ever-use for women age 15-19, although still above the levels in most other African countries.

Figure B-27.3. Trends in age-specific ever-use of contraception, South Africa



28. Swaziland

Only one survey was available in Swaziland, conducted in 2006. Like South Africa, Swaziland is also very advanced in the marriage, education, contraception, and fertility transitions.

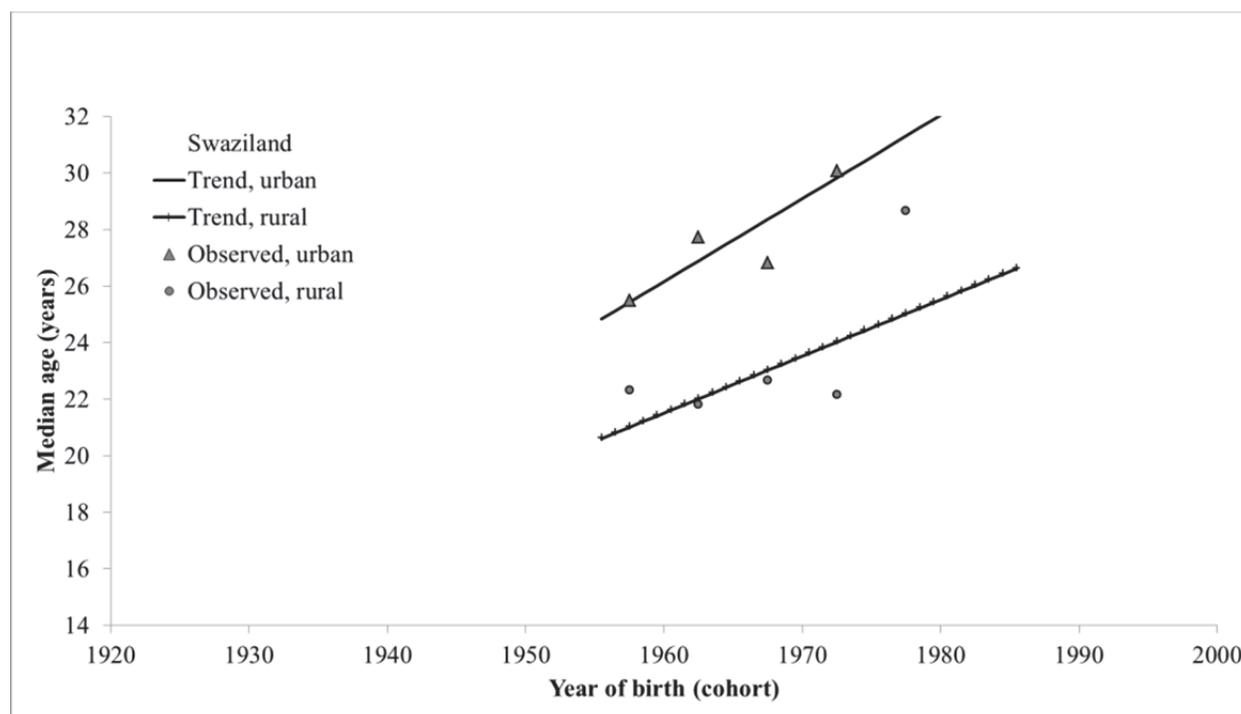
Table B-28.1. Survey characteristics, Swaziland

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 2006 | 4,987 | 25.6 | 8.09 | 69.8 |

Trends in age at marriage (Figure B-28.1)

As in South Africa, median age at first marriage was high and rising rapidly in both urban and rural areas. Median age could not be computed for the most recent cohorts in urban areas, since less than 50% of women had ever-married.

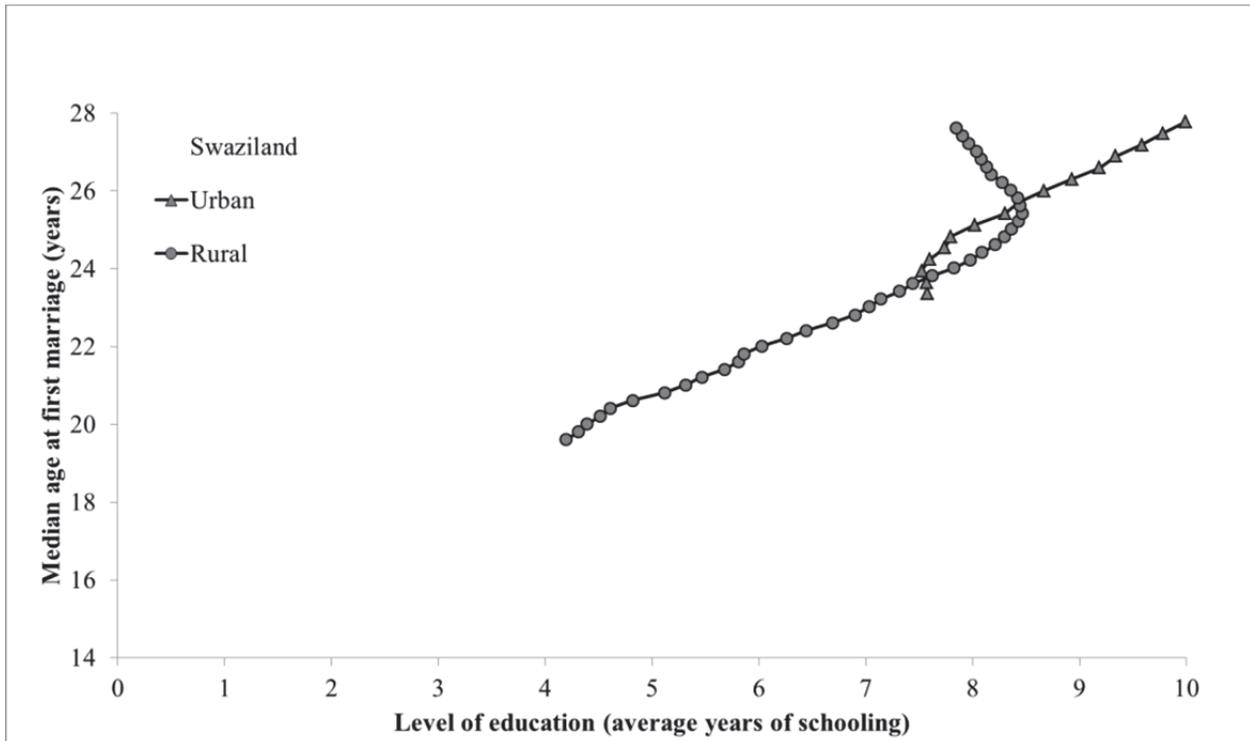
Figure B-28.1. Reconstructed trends in median age at first marriage, Swaziland



Relationship with education (Figure B-28.2)

The relationship between trends in level of education and in age at marriage was linear in urban areas, but not in rural areas, where level of education declined while age at marriage continued to increase.

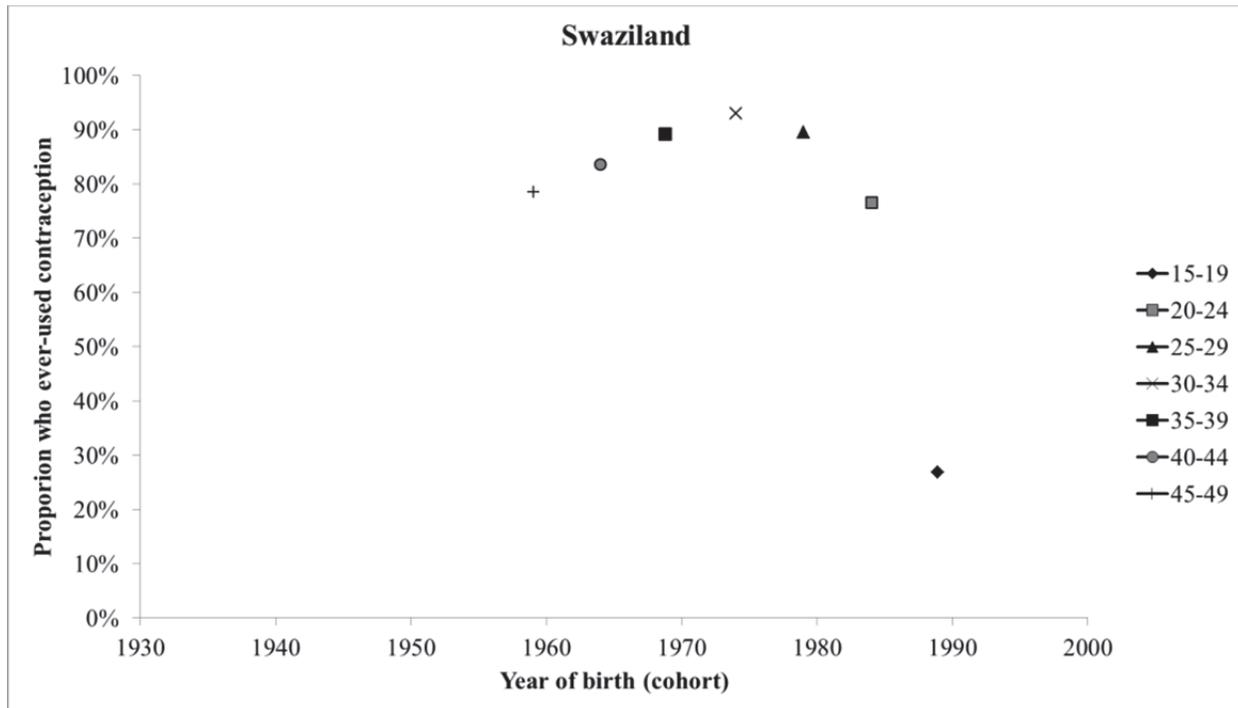
Figure B-28.2. Relationship between level of education and age at first marriage, Swaziland



Trends in contraceptive use (Figure B-28.3)

Ever-use of contraception was very high for the 1950-1975 cohorts, reaching 90% for women age 30-34, with a mild cohort trend. The age effect was small, however, with a smaller prevalence for the 15-19 age group, a situation similar to that of South Africa.

Figure B-28.3. Trends in age-specific ever-use of contraception, Swaziland



29. Tanzania

Five surveys were available in Tanzania, conducted in 1991, 1996, 1999, 2004, and 2010. Overall, they were compatible for the three variables investigated, with a low value of age at marriage in 1999. The 2010 survey had no information on ever-use of contraception.

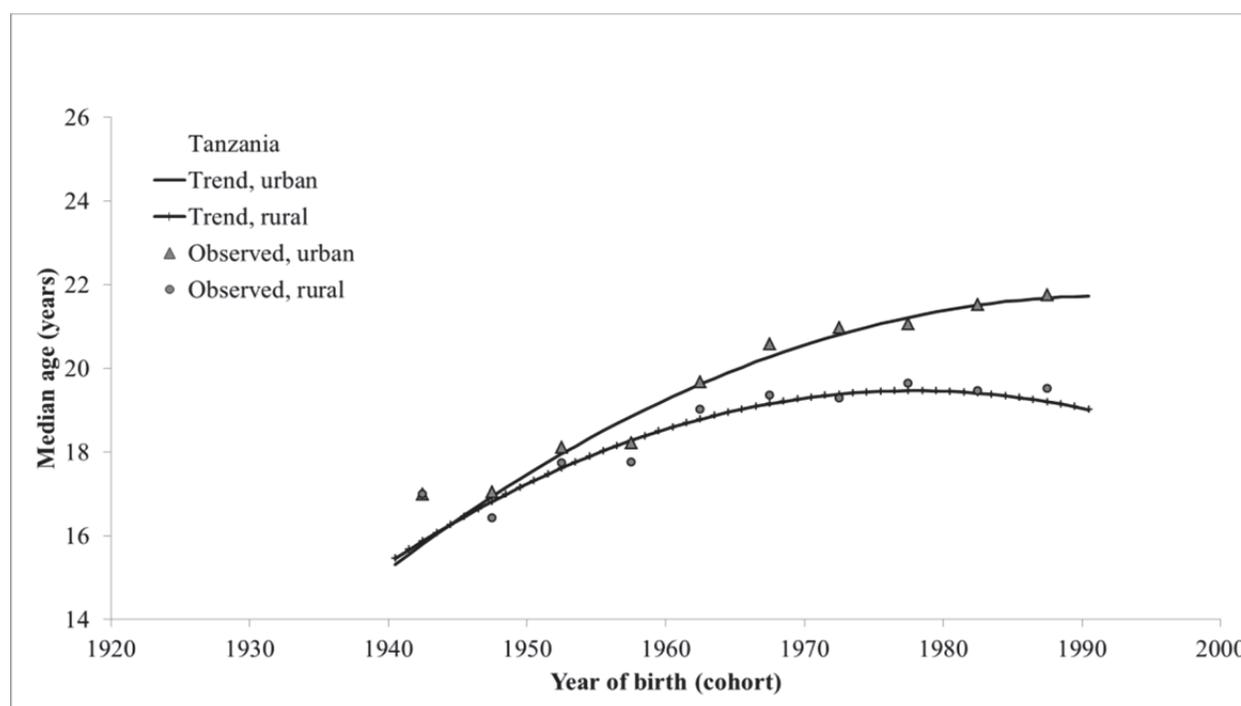
Table B-29.1. Survey characteristics, Tanzania

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1991 | 9,238 | 17.9 | 4.22 | 14.1 |
| DHS | 1996 | 8,120 | 18.2 | 4.56 | 22.6 |
| DHS | 1999 | 4,029 | 18.1 | 4.70 | 29.9 |
| DHS | 2004 | 10,329 | 18.6 | 5.18 | 37.1 |
| DHS | 2010 | 10,139 | 18.8 | 5.74 | |

Trends in age at marriage (Figure B-29.1)

Median age at first marriage was low in Tanzania for cohorts born in the 1940s, with hardly any difference between urban and rural areas. Age at marriage increased steadily in urban areas, faster for cohorts born between 1950 and 1970, and slower for later cohorts. The pattern was similar for rural areas, although age at marriage stopped increasing for cohorts born after 1975.

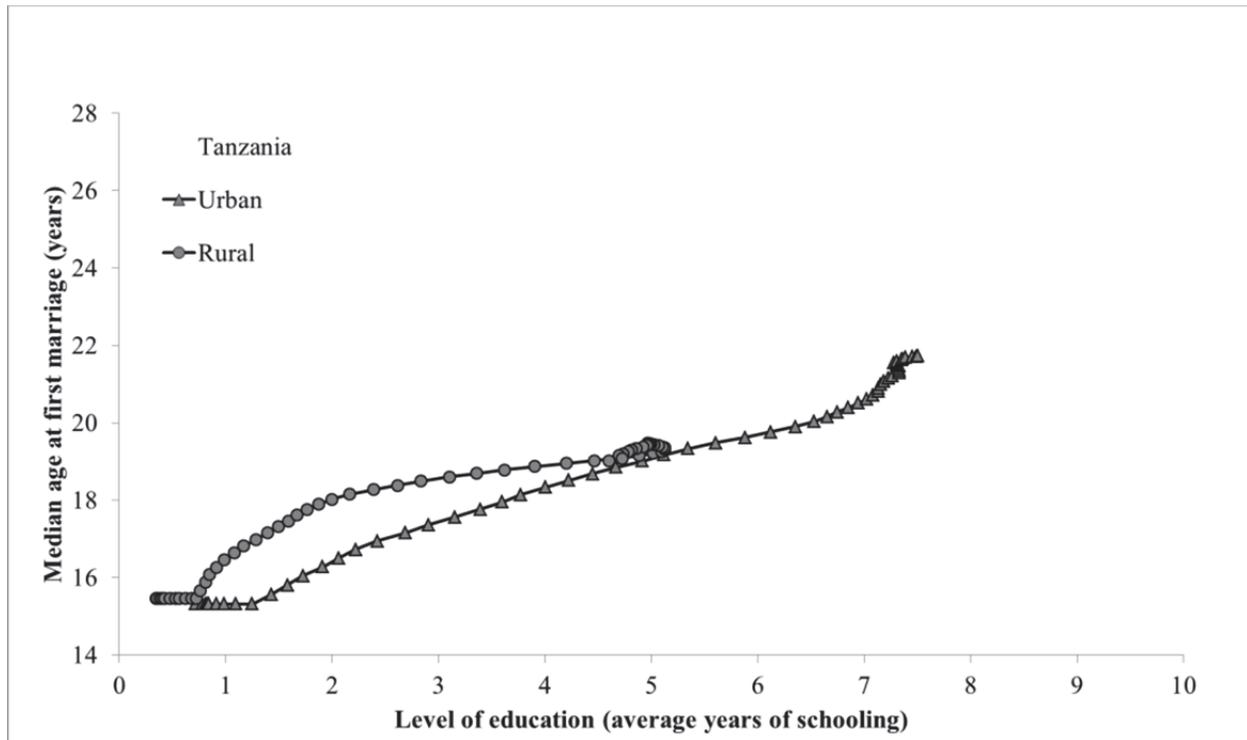
Figure B-29.1. Reconstructed trends in median age at first marriage, Tanzania



Relationship with education (Figure B-29.2)

The relationship between trends in level of education and in age at marriage was quite monotonic, with only some minor variations in the recent cohorts. In urban areas age at marriage continued to increase despite a decline in level of education, while in rural areas both stagnated for the recent cohorts.

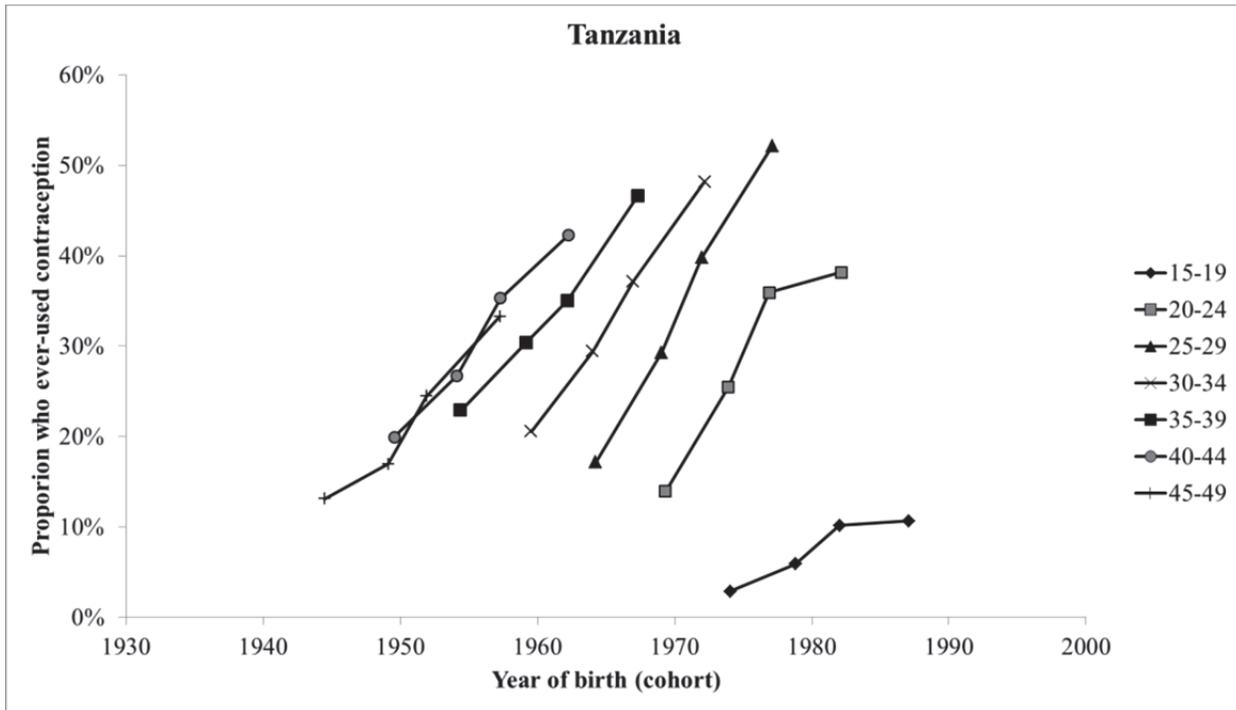
Figure B-29.2. Relationship between level of education and age at first marriage, Tanzania



Trends in contraceptive use (Figure B-29.3)

Contraceptive use increased steadily for all cohorts considered, reaching medium levels for the mid-aged women. However, levels of ever-use remained low for women age 15-19.

Figure B-29.3. Trends in age-specific ever-use of contraception, Tanzania



30. Togo

Two surveys were available in Togo, conducted in 1988 and 1998. They were compatible with respect to the three variables investigated.

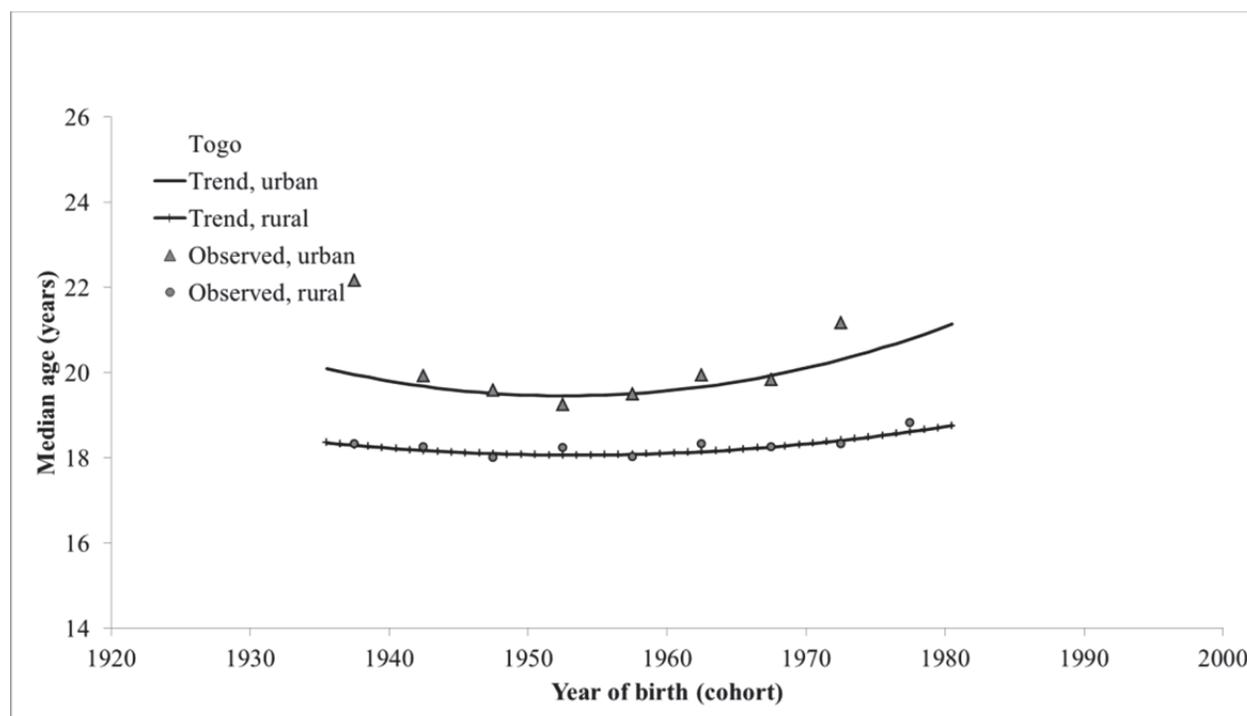
Table B-30.1. Survey characteristics, Togo

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1988 | 3,360 | 18.3 | 2.32 | 10.7 |
| DHS | 1998 | 8,569 | 18.8 | 2.59 | 26.0 |

Trends in age at marriage (Figure B-30.1)

Median age at first marriage was average in Togo, for cohorts born in the 1930s and 1940s, with a small gap between urban and rural areas. It increased in urban areas for cohorts born after 1950, while remaining almost constant in rural areas.

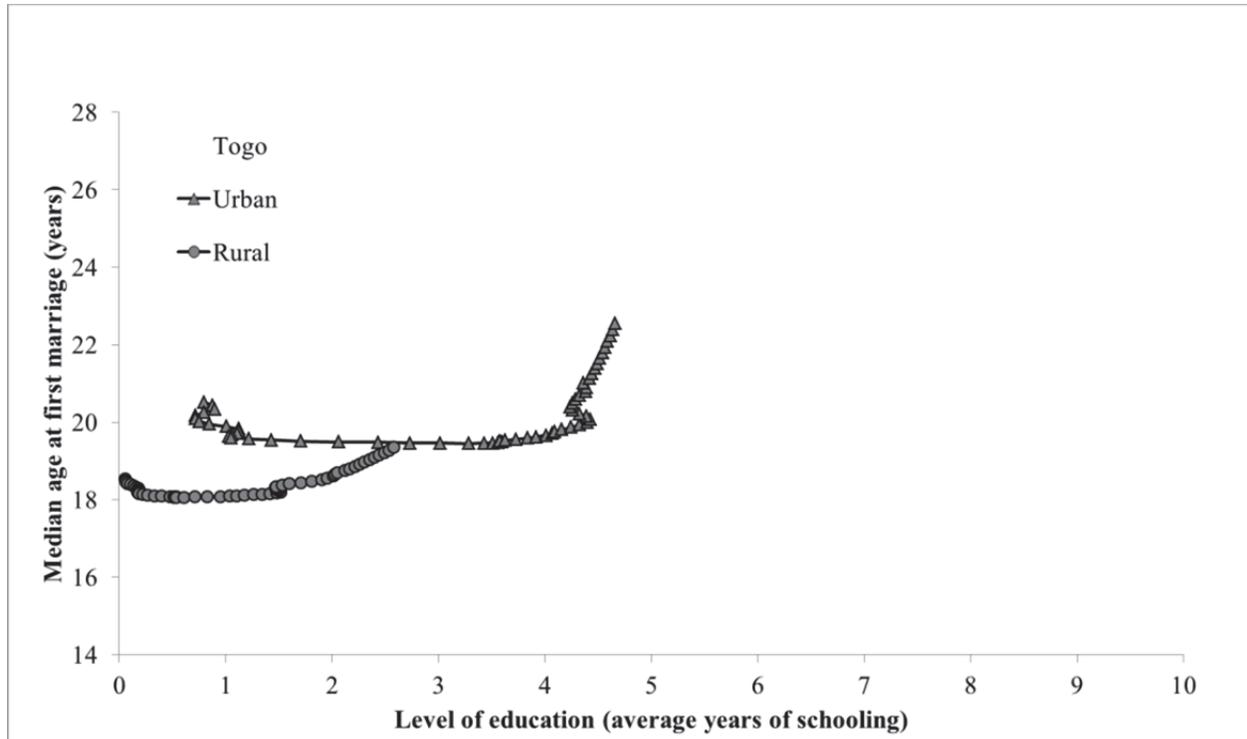
Figure B-30.1. Reconstructed trends in median age at first marriage, Togo



Relationship with education (Figure B-30.2)

The relationship between trends in level of education and in age at marriage was not linear. For a long time, there was hardly any change in age at marriage in urban areas, despite an increasing level of education. Then age at marriage increased while level of education did not change. In rural areas the relationship was more straightforward, although at low levels of education and with minor changes in age at marriage.

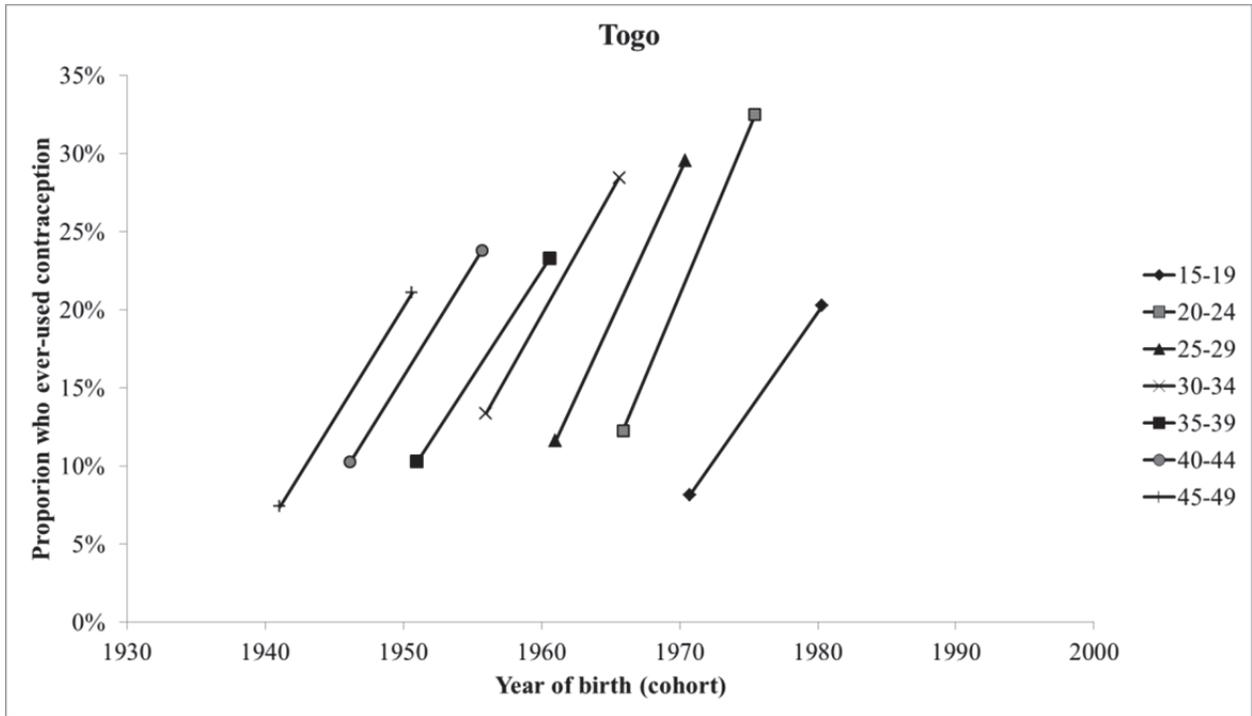
Figure B-30.2. Relationship between level of education and age at first marriage, Togo



Trends in contraceptive use (Figure B-30.3)

Contraceptive use increased steadily for cohorts considered, reaching average values for the mid-aged women, and relatively small age effects, underlying a strong period effect. Compared with other countries, the proportion of women who ever-used contraception was particularly high for women age 15-19.

Figure B-30.3. Trends in age-specific ever-use of contraception, Togo



31. Uganda

Five surveys were available in Uganda, conducted in 1988, 1995, 2001, 2006 and 2011. They were compatible for the three variables investigated, with minor changes for period age at marriage. The 2011 survey did not provide data on ever-use of contraception.

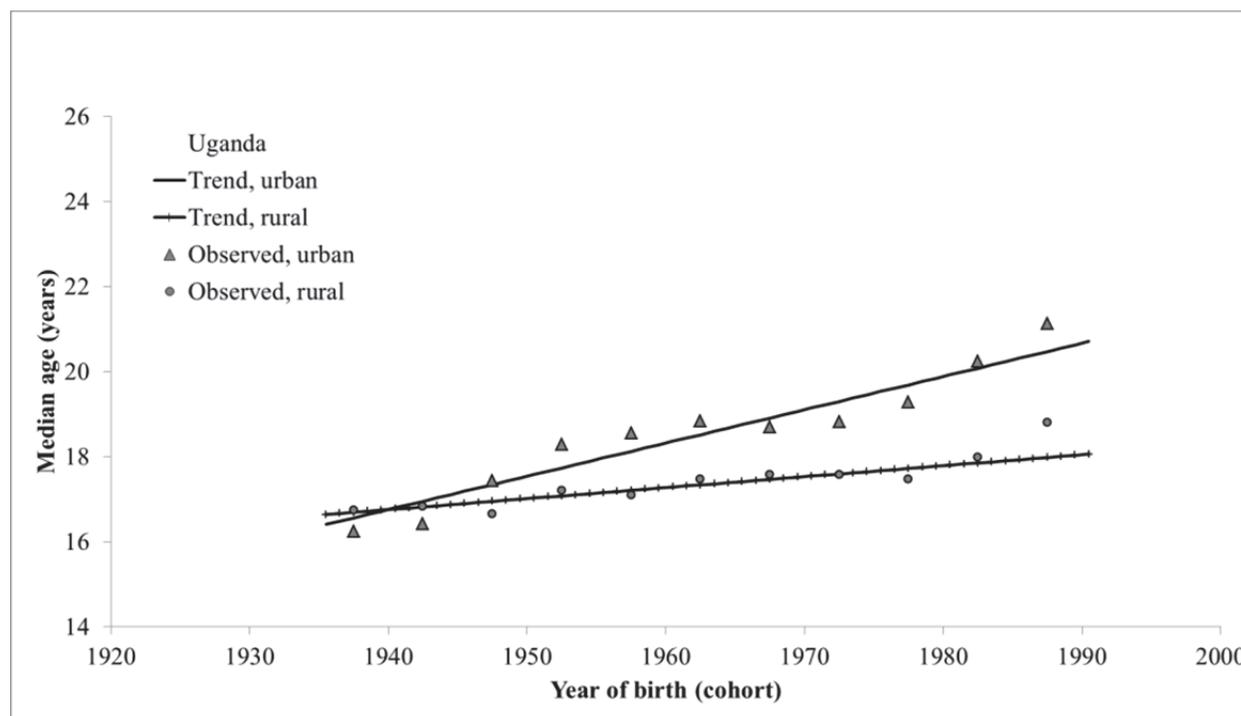
Table B-31.1. Survey characteristics, Uganda

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1988 | 4,730 | 17.0 | 3.29 | 7.4 |
| DHS | 1995 | 7,070 | 17.4 | 3.78 | 15.7 |
| DHS | 2001 | 7,246 | 17.8 | 4.54 | 34.9 |
| DHS | 2006 | 8,531 | 17.6 | 4.96 | 38.1 |
| DHS | 2011 | 8,674 | 17.9 | 5.74 | |

Trends in age at marriage (Figure B-31.1)

Median age at first marriage was rather low in Uganda for cohorts born in the mid 1930s, with virtually no difference between urban and rural areas. Age at marriage increased almost steadily in urban areas, as well as in rural areas but at a slower speed.

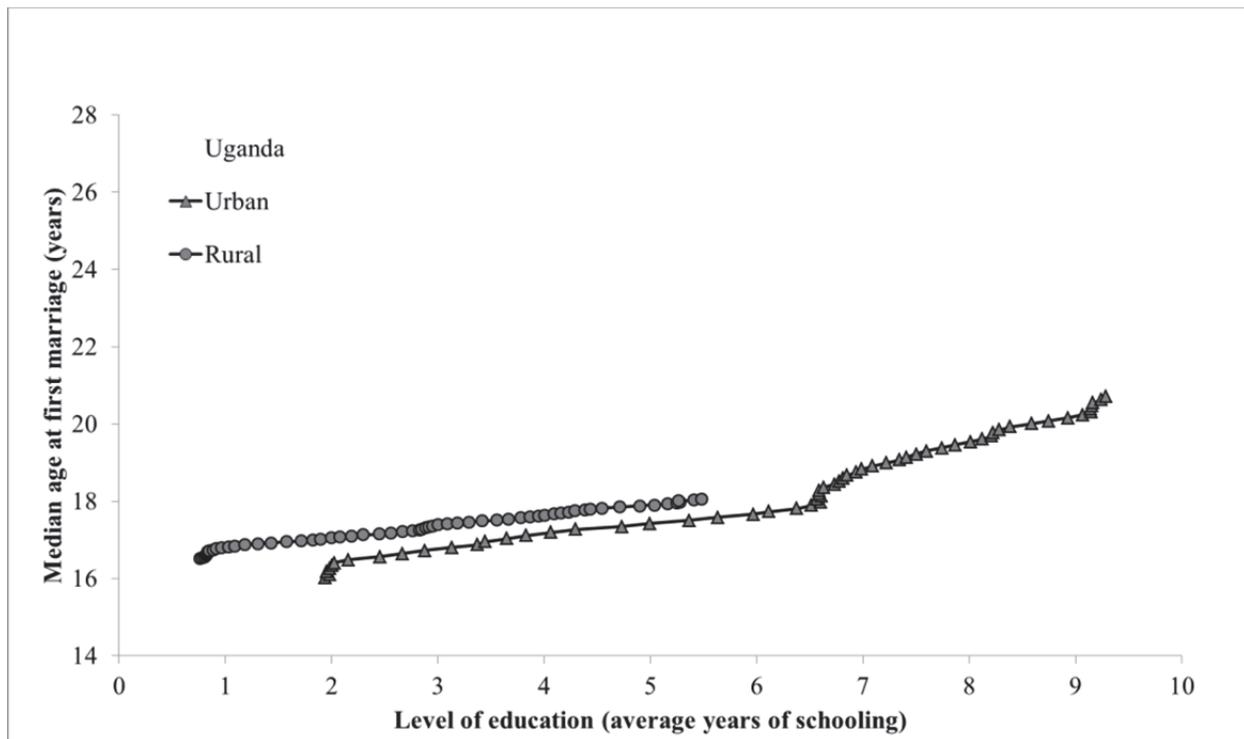
Figure B-31.1. Reconstructed trends in median age at first marriage, Uganda



Relationship with education (Figure B-31.2)

The relationships between trends in level of education and in age at marriage were basically monotonic and linear in both urban and rural areas, with some acceleration in urban areas due in part to faster increase in level of education.

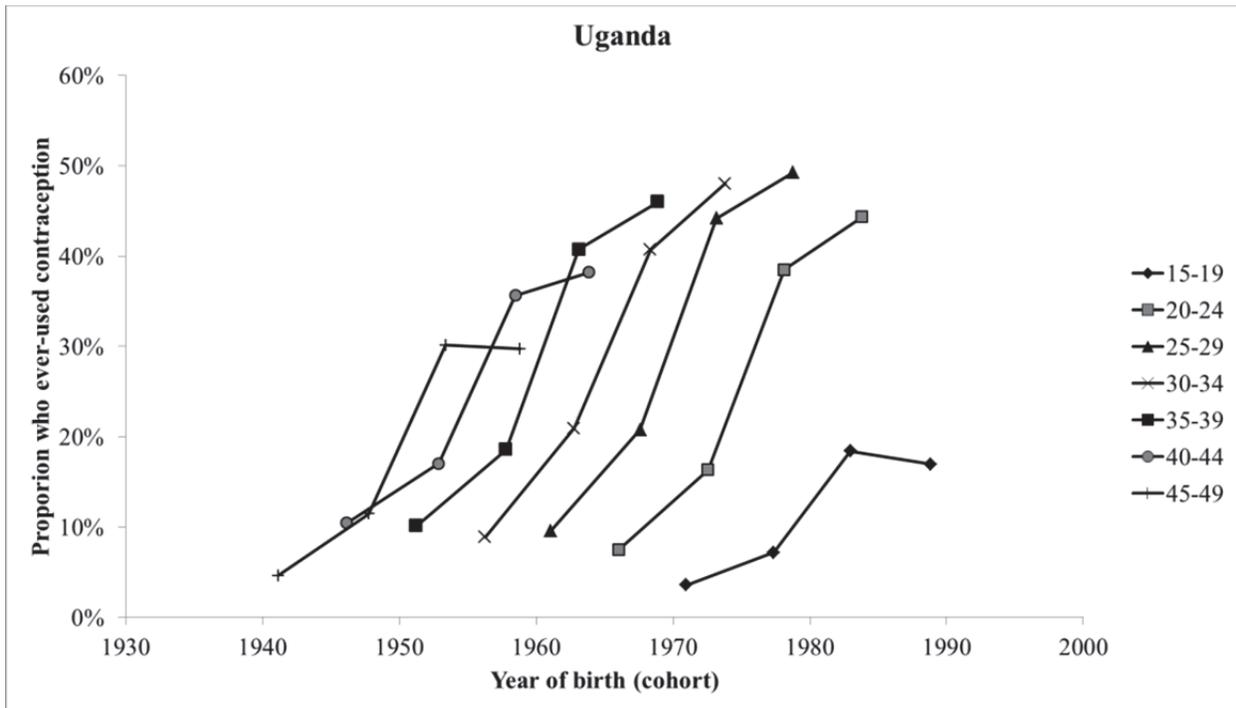
Figure B-31.2. Relationship between level of education and age at first marriage, Uganda



Trends in contraceptive use (Figure B-31.3)

Ever-use of contraception increased steadily for cohorts considered, with only a minor stagnation for the 45-49 and the 15-19 age groups. The level reached an average value (almost 50%) for mid-aged women, and remained low for women age 15-19.

Figure B-31.3. Trends in age-specific ever-use of contraception, Uganda



32. Zambia

Four surveys were available in Zambia, conducted in 1992, 1996, 2001, and 2007. They were compatible with respect to the three variables investigated.

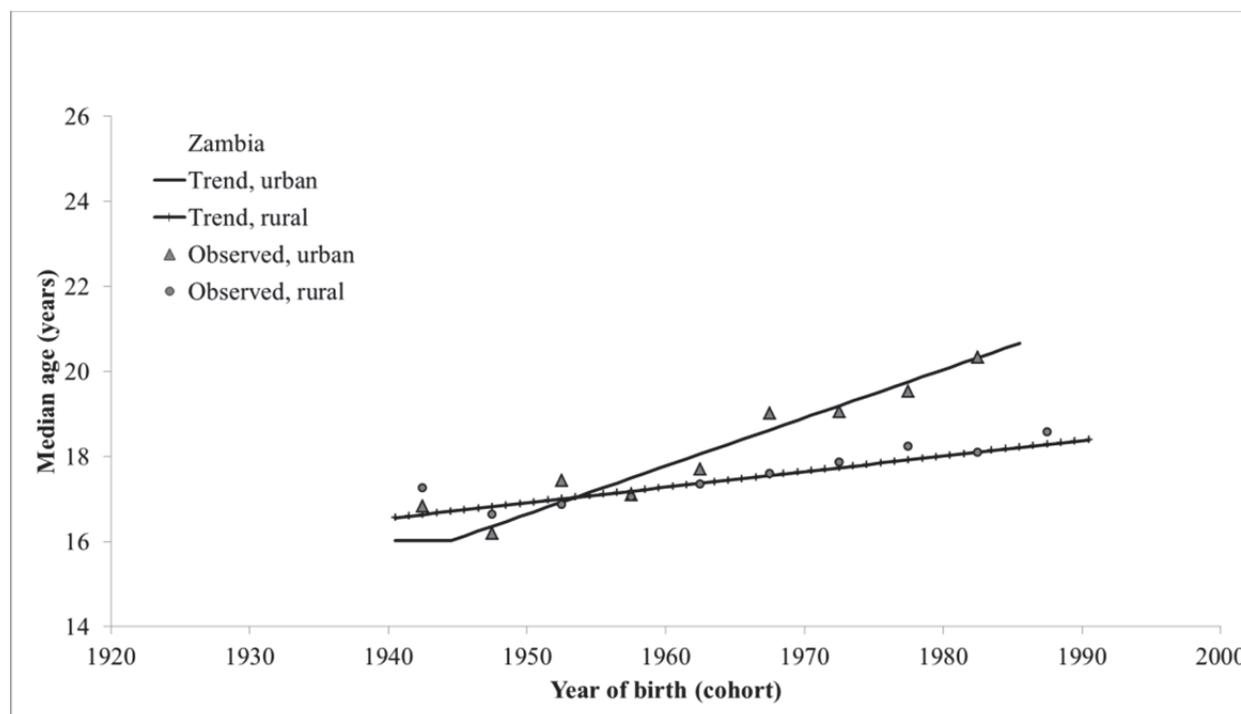
Table B-32.1. Survey characteristics, Zambia

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1992 | 7,060 | 17.4 | 5.25 | 22.9 |
| DHS | 1996 | 8,021 | 17.7 | 5.68 | 32.6 |
| DHS | 2001 | 7,658 | 17.8 | 5.87 | 45.7 |
| DHS | 2007 | 7,146 | 18.2 | 6.40 | 56.3 |

Trends in age at marriage (Figure B-32.1)

Median age at first marriage was low in Zambia for cohorts born in the 1940, with hardly any difference between urban and rural areas. It increased steadily in both urban and rural areas for cohorts born after 1950, faster in urban than rural areas.

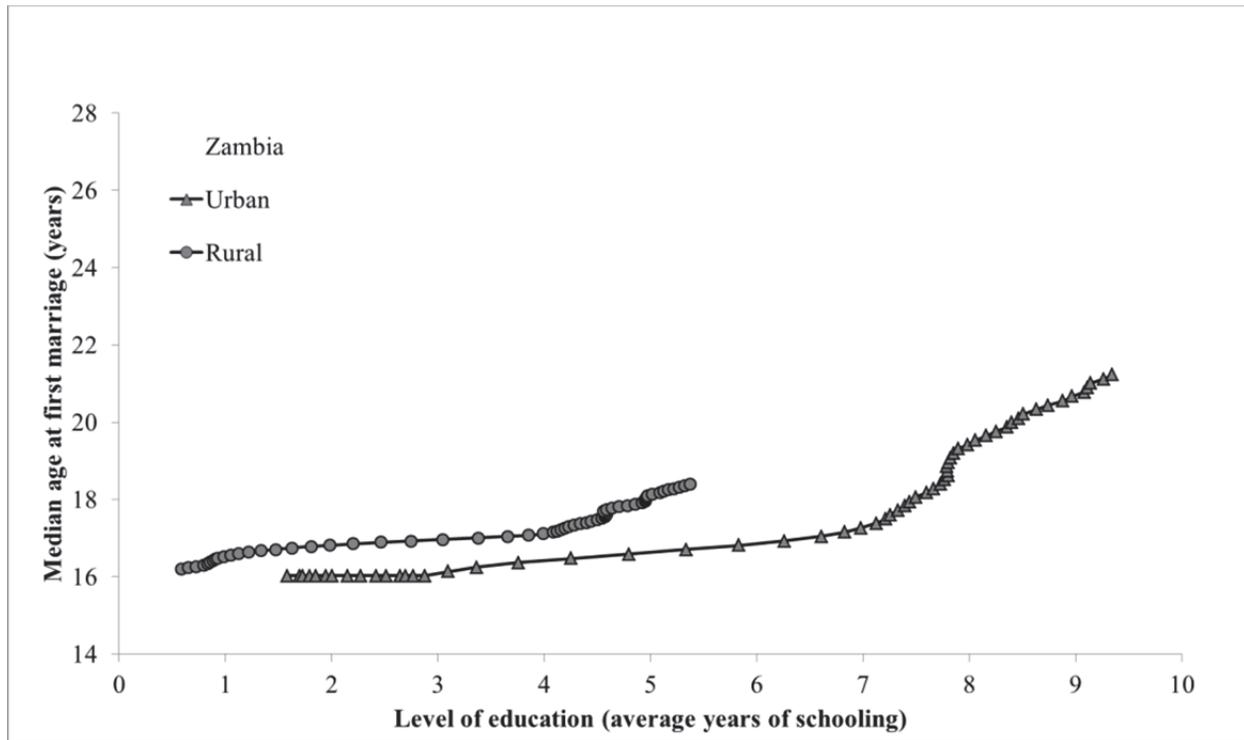
Figure B-32.1. Reconstructed trends in median age at first marriage, Zambia



Relationship with education (Figure B-32.2)

The relationship between trends in level of education and in age at marriage was monotonic, although increasing for the more recent cohorts. This was due to a faster increase in level of education for cohorts born after 1945.

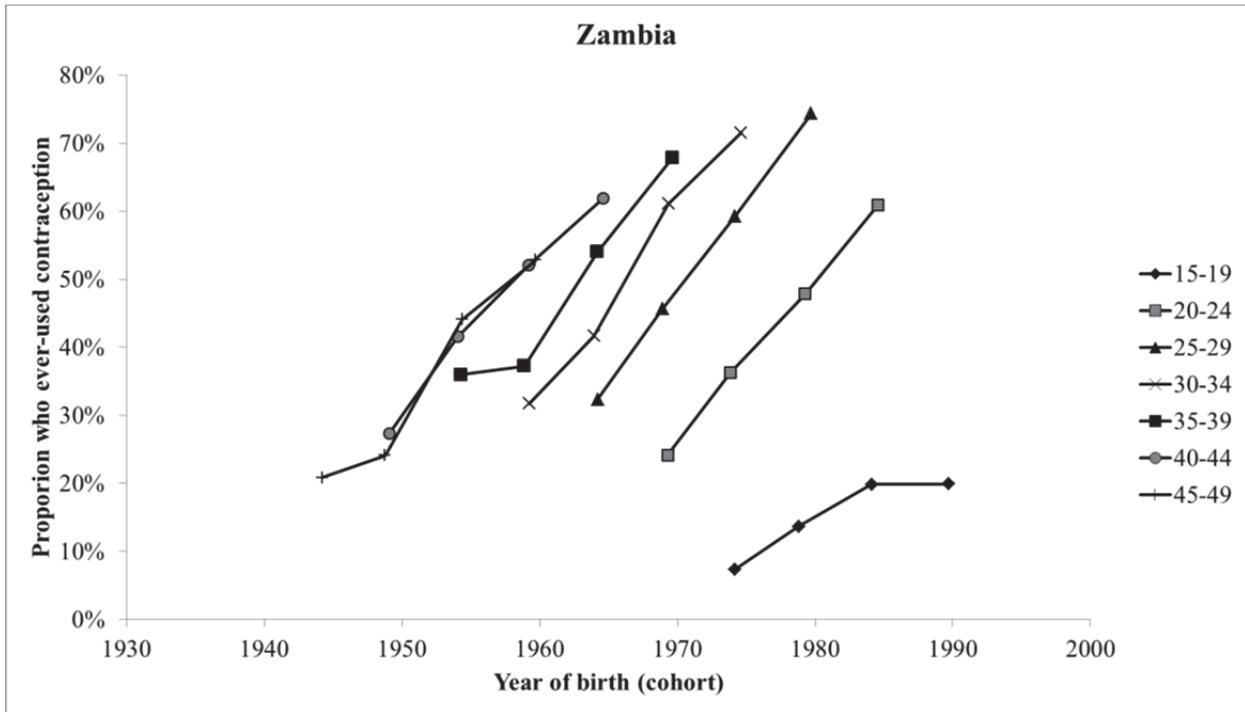
Figure B-32.2. Relationship between level of education and age at first marriage, Zambia



Trends in contraceptive use (Figure B-32.3)

Contraceptive use increased steadily for all cohorts considered, reaching high levels (above 70%) for the mid-aged women. Only women age 15-19 showed a low level of ever-use of contraception.

Figure B-32.3. Trends in age-specific ever-use of contraception, Zambia



33. Zimbabwe

Five DHS surveys were available in Zimbabwe, conducted in 1988, 1994, 1999, 2005 and 2010. They were compatible with respect to the three variables investigated. The 2010 survey, however, did not provide information on ever-use of contraception.

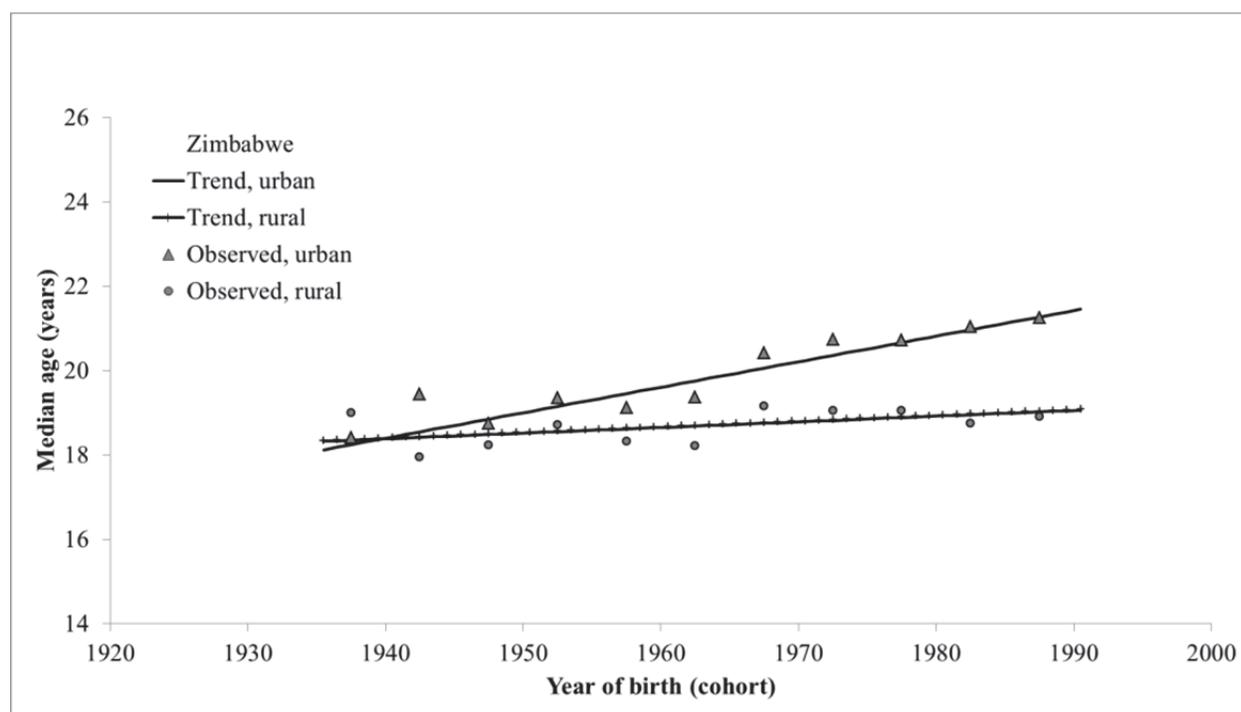
Table B-33.1. Survey characteristics, Zimbabwe

| Survey | Year | Sample size (number of women) | Median age at first marriage (years) | Mean level of education (years of schooling) | Ever-use of contraception (percent) |
|--------|------|----------------------------------|--|--|---|
| DHS | 1988 | 4,201 | 18.6 | 6.05 | 48.4 |
| DHS | 1994 | 6,128 | 18.9 | 6.74 | 56.1 |
| DHS | 1999 | 5,907 | 19.3 | 7.81 | 60.8 |
| DHS | 2005 | 8,907 | 19.3 | 7.89 | 65.6 |
| DHS | 2010 | 9,171 | 19.7 | 9.02 | |

Trends in age at marriage (Figure B-33.1)

Median age at first marriage was average in Zimbabwe for cohorts born in the 1940s, with virtually no difference between urban and rural areas. Age at marriage increased steadily in urban areas, but hardly changed in rural areas.

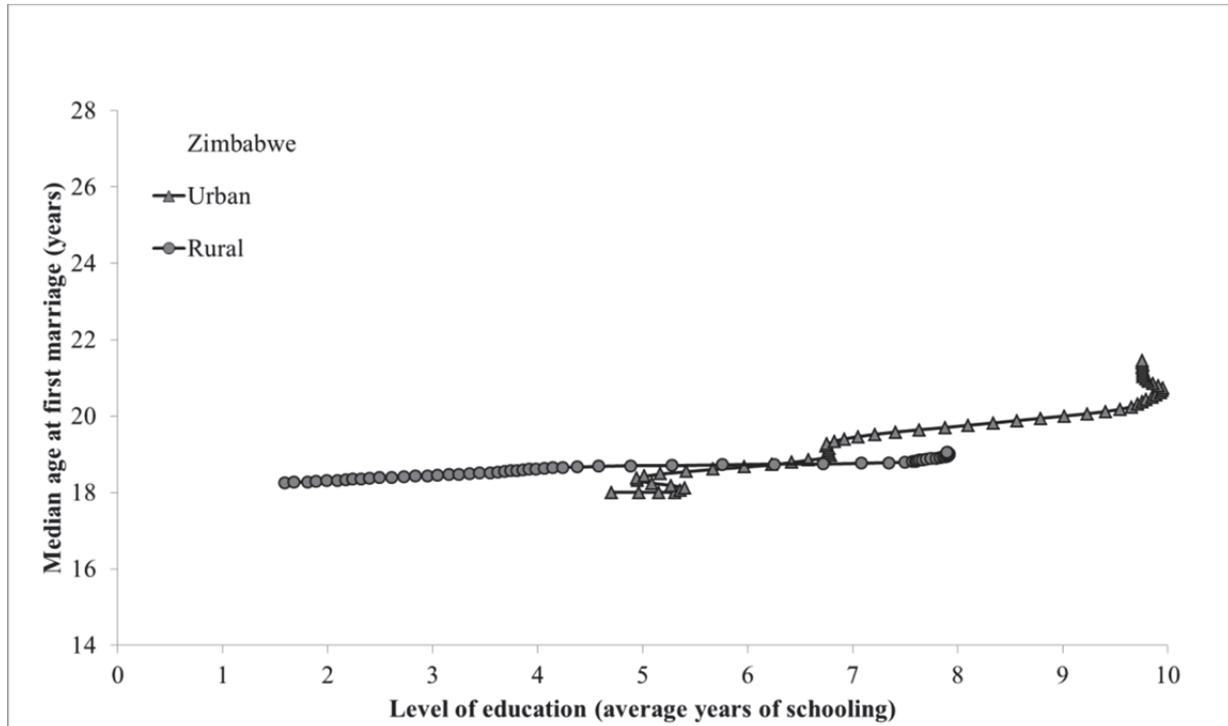
Figure B-33.1. Reconstructed trends in median age at first marriage, Zimbabwe



Relationship with education (Figure B-33.2)

The relationship between trends in level of education and in age at marriage remained flat for a long time, and the strong increase in level of education for cohorts born between 1930 and 1964 hardly translated into any increase in age at marriage. Conversely, in urban areas, age at marriage increased for the recent cohorts (1965-1985), while level of education stagnated. In rural areas age at marriage remained constant despite fluctuations in level of education.

Figure B-33.2. Relationship between level of education and age at first marriage, Zimbabwe



Trends in contraceptive use (Figure B-33.3)

Ever-use of contraception increased steadily for all cohorts considered, and was high even for the early cohorts (born in the 1940s), reaching values greater than 90% for the mid-aged women. Ever-use of contraception was low only for women age 15-19, and increased slowly.

Figure B-33.3. Trends in age-specific ever-use of contraception, Zimbabwe

