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ABSTRACT

Some studies have suggested that the fertility decline in several sub-Saharan African countries has stalled in recent years. These studies have reached contradictory conclusions about the extent and mechanisms of fertility stalls, however, and the actual number of stalls may be overstated, due to limitations of the available data. This report re-examined recent fertility trends in Benin, Cameroon, Ghana, Kenya, Nigeria, Rwanda, Tanzania, Uganda, and Zambia, where national total fertility rates (TFRs) appear to have failed to decline around 2000. In our re-examination we used three sets of data quality assessments to examine the impact of survey-related errors on the estimation of recent fertility trends. The smoothed long-term TFR trends resulting from our analysis provided compelling evidence of a stall in Kenya's fertility decline. Benin, Rwanda, and Zambia also appeared to have stalled fertility declines. However, other stalls in fertility decline reported by previous studies appeared to be overstated. This is likely due to age displacement of children, omission, or differences between the surveys in the late 1990s and those in the early 2000s. The report recommends careful assessment of fertility trends that take into account the quality of survey data, as well as efforts to maintain the high level of DHS data quality.

INTRODUCTION

Sub-Saharan Africa is the only region of the world where fertility is persistently high. Since the 1980s, fertility has declined in several sub-Saharan countries, and most parts of the region are now considered to be in the middle of the fertility transition. However, recent studies have observed unexpected stalling in the fertility decline in several sub-Saharan countries (Bongaarts 2006, 2008; Garenne 2008; Schoumaker 2009; Sneeringer 2009; Westoff and Cross 2006).

The studies have reached contradictory conclusions about the extent and mechanisms of these apparent fertility stalls (Table 1). Bongaarts (2006, 2008) identified 12 sub-Saharan African countries with stalled fertility decline around 2000.[1] Schoumaker (2009) found fertility stalls only in Kenya and possibly in Rwanda, while Garenne (2008) reported that fertility decline has stalled in six countries.[2] Westoff and Cross (2006) also found evidence of a stall in fertility decline in Kenya. Sneeringer (2009) examined cohort fertility trends and suggested that only in Congo (Brazzaville) and Madagascar have fertility transitions slowed.

[1] The 12 countries are Cameroon, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mozambique, Nigeria, Rwanda, Tanzania, Uganda, Zambia, and Zimbabwe.
[2] Ghana, Kenya, Madagascar (urban), Nigeria, Rwanda (rural), and Tanzania (rural).

Table 1: Comparison of literature on stalling fertility

Country/Period	Bongaarts[1]	Garenne 2008	Schoumaker 2009	Sneeringer 2009[2]
Benin				
2001-06	**Stall**	Decline	Early transition	Decline
Cameroon				
1998-04	**Stall**	Decline	Decline	Decline
Ghana				
1998-03	**Stall**	**Stall**	Decline	Decline
2003-08	Decline	-	-	-
Kenya				
1998-03	**Stall**	**Stall**	**Stall**	Decline
Nigeria				
1999-03	**Stall**	**Stall**	Early transition	Decline
2003-08		-	-	-
Rwanda				
2000-05	**Stall**	**Stall**	**Stall**[3]	Decline
2005-07/8[4]	Decline	-	-	-
Tanzania				
1999-04	**Stall**	**Stall**	Decline	-
Uganda				
1995-00/1	**Stall**	Decline	Pre-transition	Decline
2000/1-06		-		
Zambia				
1996-01/2	**Stall**	Decline	Decline	Decline
2001/2-08		-	-	-

- The latest DHS survey was not included for the study.
[1] The trends are determined using Bongaarts' method (Bongaarts 2008).
[2] Cohort fertility was used.
[3] Stall in Rwanda was less certain.
[4] The dataset for Rwanda interim DHS 2007/8 has not been released as of 31 May, 2010.

In this study we hypothesized that the number of observed fertility stalls might be overstated due to limitations of analysis related to the quality and nature of the DHS data used in making the estimates. The fertility stalls estimated in earlier studies often relied on selected average TFRs derived from DHS STATcompiler (Askew et al. 2009; Bongaarts 2006, 2008; Ezeh, Mberu and Emina 2009; Shapiro and Gebreselassie 2008; Westoff and Cross 2006). This analytic approach can produce a misleading impression of fertility trends.

The DHS provides the most reliable information on national fertility levels, but no survey is immune to errors, and there is abundant evidence that such errors tend to be more pervasive in sub-Saharan Africa than elsewhere (Arnold 1990; Johnson et al. 2009; Pullum 2006; Rutstein and Bicego. 1990). The most serious and measurable problem in using this type of cross-sectional household survey data to examine demographic trends is age displacement of children. In the DHS protocol, women with children born during a predetermined number of years prior to the survey (generally three or five years) are asked a range of questions on maternal and child health related to the children, which women are not asked to answer for children age the predetermined year or older. As a result, interviewers could be motivated to transfer dates of childbirths backward to avoid asking the additional questions and thus to reduce their workloads. In fact, births occurring 0-5 years before a survey tend to be pushed backwards, resulting in underestimation of births during the period and in overestimation of births six and more years before the survey.

This pattern of age transfer can exaggerate the speed of fertility decline (Goldman, Rutstein and Singh 1985; Potter 1977). A published TFR in a DHS report is usually an average of TFRs during the three years before a survey, to avoid the underestimation of births in the boundary year (Rutstein and Rojas 2006). Nevertheless, a number of children may be underestimated throughout the five-year period after the boundary year.

In the past few years, concern has been growing that the increasing number of questions in the DHS questionnaire may adversely affect the quality of the data (Murray et al. 2007), but the effect of the data quality on the estimation of recent fertility trends in sub-Saharan Africa has not been widely studied. If one survey has poorer data quality than the successive survey(s), it may distort the measurement of fertility trends, causing an erroneous impression of a fertility decline or stall. Furthermore, few studies have proposed methods for adjusting for age

displacement (Sullivan 2008). Thus there is a clear need for a more rigorous method of examining fertility trends that allows for the errors inherent in the surveys.

This paper makes three sets of data assessments to identify drawbacks of the current method of identifying fertility stalls, re-examines fertility changes in light of these assessments, and provides plausible interpretations of the recent fertility declines in the sub-Saharan countries studied. Adapting Gendell's definition, we define a fertility stall as a trend when the average annual pace of fertility decline during a DHS inter-survey period is less than half the pace in the previous inter-survey period, in the countries where TFRs have dropped by over 20 percent from the highest observed TFR (Gendell 1985). The highest estimates of TFRs were obtained from the UN 2008 World Population Prospects Data between 1950-2000 (United Nations 2009).

DATA and METHODS

Data

Our study used individual, birth, and household member datasets from 33 DHS surveys in nine sub-Saharan African countries. The countries were selected because the national TFRs appeared to have levelled off between successive DHS surveys conducted around 2000. These countries and survey years are Benin (1996, 2001, 2006), Cameroon (1991, 1998, 2004), Ghana (1988, 1993, 1998, 2003, 2008), Kenya (1989, 1993, 1998, 2003),[3] Nigeria (1990, 1999, 2003, 2008), Rwanda (1992, 2000, 2005), Tanzania (1991/92, 1996, 1999, 2004/05), Uganda (1995, 2000/01, 2006),[4] and Zambia (1992, 1996, 2001/02, 2007). Uganda and Tanzania were included despite the fact that their TFRs have not declined substantially based on the definition described earlier.

Methods

As mentioned, our analysis involved three sets of data assessment and a re-examination of recent fertility trends in sub-Saharan Africa. First, the paper extended the work by Pullum on assessment of age and date misreporting, published as DHS Methodological Report 5 (Pullum 2006), because age and dates of birth of respondents and their children are critically important for estimating fertility. Second, retrospective annual fertility rates were estimated for each survey in order to identify the effects of children's age displacement on fertility changes, as well as discrepancies in the estimates derived from two successive surveys. We also used these rates to derive detailed fertility estimates and the long-term smoothed fertility trends for each country. Third, possible reasons for the discrepancies in fertility rates were explored by comparing the composition of women according to educational attainment and average parity. These various analyses led us to provide plausible interpretations of recent trends (see the discussion section). STATA SE/11 was used for the entire analysis.

[3] To ensure comparability in the data for the entire period, North-East Province and four other northern districts that were covered only in the 2003 Kenya DHS survey were excluded from this analysis.
[4] The Uganda 1988 DHS was excluded on account of the limited geographical area. Also the current two western and four northern districts were excluded from Uganda datasets to ensure comparability.

Assessment of age and date misreporting

In the first part of our analysis, we updated Pullum's assessment of age and date misreporting in DHS data (Pullum 2006) by focusing on: (a) the incompleteness of reporting age and birth dates of women and children; (b) digit preference in age reporting; and (c) age displacement of women and children, for the countries included in the study.

(a) Incompleteness of birth dates of women and children

To calculate proportions of women and children who possess the essential information on date of birth and current age, we used a variable in the individual and birth datasets that indicates whether all three pieces of information (current age and year and month of birth) were provided, or if imputation of this information was needed.

(b) Digit preference in age reporting

Myers' blended Index was used to detect digit preference in women's age reporting. This commonly used index measures proportions of women whose current age have been shifted from one final digit to another. There is often a tendency to round down or up current age and report another age ending in 0 or 5. The blended index adjusts for the fact that there are more people at age x than at x+1, due to births and deaths (Myers 1940; Siegel and Swanson 2004). The higher the value, the more dissimilarity exists. The STATA command myers, developed by Pullum and Rodríguez, was used to compute the indices (Rodríguez 2006). This analysis focused on digit preference in reporting current age among women age 15-44, to have equal representation of all final digits (0-9).

(c) Age displacement of women and children

Age displacement refers to the systematic transfer of respondents and children across an age boundary for eligibility for specific survey questions. The method formulated by Pullum was used here to estimate the proportion of downward and upward age displacement of women, and age displacement of children (Pullum 2006). Pullum reformulated the conventional method to measure age displacement, i.e. age ratio, to make it interpretable and to estimate the number and proportions of women transferred, using individual-level data (Pullum 2006). This method was used to quantify the displacement and also used later to adjust for the errors to re-estimate fertility rates. We could not apply this method to estimate women's transfer to the 1988 Ghana

DHS and the 1989 Kenya DHS, since the ages of household members are not stored in these datasets.

Estimation of recent fertility trends by single calendar year

Retrospective TFRs by single calendar year were obtained by reconstructing birth histories for the 10 years preceding each survey. This aimed to depict the detailed levels and trends of fertility and to identify age displacement of children, as well as discrepancies in the estimates derived from two successive surveys during overlapping periods. A similar method has been used for data assessments in the 1980s and in a few recent studies (Garenne 2008; Schoumaker 2009). Partial TFRs were computed by cumulating age-specific fertility rates among women age 15-39, because women age 40-49 at 10 years prior to the time of a survey (i.e. women age 50-59 at the time of the survey) were truncated from the individual dataset.[5,6] The confidence limits for the annual estimates were computed by Jackknife repeated replication, a method that DHS surveys use to report confidence intervals for TFRs. In the Jackknife method, TFRs are repeatedly calculated for replications of the dataset, each of which includes all but one cluster, and the standard error on TFRs is then calculated.[7]

Long-term trends in each country were presented by employing locally weighted scatter point smoothing (Loess), which produces a new smoothed value for each data point by running a linear regression with the highest weight on the data point and less weight on other points according to their distance from the data point. This procedure was repeated to obtain smoothed values for every point, and the smoothed values were connected with a line. This Loess regression is an increasingly used robust technique to perform locally-weighted smoothing. The smoothing window for this analysis was 0.8.

[5] The data in the year that data collection ended covers a small fraction of births and exposure that would have occurred in the whole year. Consequently, the estimated rate would not be representative of the fertility rate in the calendar year and the reference period is likely to be distorted (Becker, S.and T.W. Pullum. 2007. "External Evaluation of the Peru Continuous Survey Experiment." Washington, DC.: USAID.). Therefore, these estimates were not reported in this paper. For Loess smoothing the estimates in the year of latest survey were not included because they might heavily affect directions of the smoothing line.

[6] Births born to mothers under age 10 (including births born in the month of mother's 10-year birthday) were excluded.

[7] The details are described in the appendix section of final DHS reports.

Furthermore, the partial TFRs were re-estimated by adjusting for age displacement of children and downward displacement of women. The estimated proportions of women age 15-19 misreported as age 10-14 were transferred back to 15-19 age group. Subsequently, partial TFRs were re-estimated under an assumption that no births had occurred among the women transferred back to the 15-19 age group, a reasonable assumption given their younger age. Births in a year preceding a boundary year and in the boundary year itself were adjusted using the proportions of children transferred between these two years, which were estimated earlier using Pullum's method. A limitation is that adjustment was made for only two years across the boundary year. This is because Pullum's method assumes that the numbers of births in the two years before and after the boundary year are correct, and that the sum of births in a year before and in the boundary year is also correct (Pullum 2006).

Inter-survey comparison: women's educational attainment

DHS surveys generally select nationally representative samples of women and men. Therefore, some socio-demographic characteristics, such as women's educational levels, are expected to remain constant or to show a gradual change within the same birth cohort across surveys. Yet if one survey over-represents a group of women with lower fertility, due to different sampling, fertility rates are likely to be lower compared with estimates from successive surveys. A fertility stall may thus be artificially created if successive surveys have different compositions of respondents. To assess difference in the compositions, this analysis compared proportions of women who attended secondary or higher levels of schooling, by 10-year birth cohort for each survey.

Inter-survey comparison: average parity

To assess differences in the composition of women, we also compared average parity by birth cohort. This method was often used to compare fertility estimates derived from World Fertility Survey data with estimates obtained from census data in the 1980s, in order to detect omissions and age displacement of children (Goldman et al. 1985). In our analysis, births after the first month of fieldwork of an earlier survey were subtracted from the data of the later survey, and the maternal history was reconstructed to compute average parity by 10-year birth cohort.

The two estimates of average parity should match, as the reference time is the same. However, if recent births were pushed backward in the later survey, the later survey may show higher average parity than the earlier survey. Also, omissions of births can be detected. This procedure was repeated for the three latest surveys for each country in our study.

RESULTS

Age and Date Misreporting

This section presents levels of age and birth date misreporting in the 33 surveys. The results, shown in Appendix 1, suggest that the levels of errors varied markedly by survey and by country. The most noteworthy points are that there was large age displacement of children in most of the surveys, including the latest surveys, and that the levels of data quality were not constant across the successive surveys.

The proportions of women who did not provide the calendar month and year of their births significantly decreased over the years in all countries. The observed improvement is more likely due to recent advancement of women's educational attainment (Arnold 1990; Pullum 2006). Nonetheless, in the most recent surveys in Benin and Rwanda more than half of the women did not report full information. Children's birth dates were substantially better reported and have dramatically improved in all countries studied.

One might expect that digit preference in women's age reporting would also improve as more women provide information on their ages and birth dates. However, noticeable increases in this misreporting were found in Benin, Ghana, Nigeria, and Tanzania. The 2006 Benin DHS showed strong digit preference ending in 0 or 5, particularly at ages 20, 25, and 30, as indicated in the DHS report (INSAE and Macro International Inc. 2007). The results suggest that the improvement in completeness of age and date reporting did not necessarily imply more accurate reporting.

Age displacement of women appeared to have improved in the recent surveys, but Benin worsened in both upward and downward age displacement of women. Also, in Nigeria, Tanzania, Uganda, and Zambia the latest survey suffered from more downward displacement of women than the preceding surveys.

The level of age displacement of all children did not improve over the survey years. Among the latest surveys, the 2006 Benin survey contained 19 percent of children transferred, while the previous two surveys had less than 10 percent of the displacement. In the 1993 Ghana DHS survey, about 20 percent of all children born were misreported to be born a year before the

boundary year. This is not a negligible level, and it is crucially important to take into account this type of error for estimating fertility trends.

Displacement among deceased children was considerably higher than among living children. Seven surveys contained more than a 30 percent displacement of children who had died—an error that may have led to large overestimation of the decline in child mortality in recent years. It is noteworthy that the displacement was found in several Phase 5 DHS surveys conducted between 2003 and 2008. In the questionnaire for Phase 5 surveys, the number of questions on pregnancy, postnatal care, and breastfeeding increased from 53 to 71, and 37 questions were newly added in the section on immunization, health, and nutrition (Macro International Inc. 2008; ORC Macro 2001). As a result, displacement might have occurred more widely because many interviewers were reluctant to ask women the health questions about their deceased children (Sullivan 2008).

Recent Fertility Trends by Single Calendar Year

Appendix 2 displays for individual countries recent changes in partial TFRs, age displacement of children, and the discrepancies in the estimates. First, general trends over the past 15 years are clearly shown by the smoothing lines. Despite various fluctuations by country, the overall trends show at least some fertility decline in all countries except Uganda and Tanzania, with only a slight decline in Zambia. Fertility declines were most rapid in Ghana and Kenya, where fertility dropped by about 40 percent over the past 20 years. In Benin, Cameroon, Nigeria, and Rwanda the decline was about 20 percent, although in Nigeria and Rwanda fertility seemed overestimated in the earliest surveys.

These results suggest that some of the apparent fertility stalls or reversals were overstated. For instance, Ghanaian fertility decline has been clearly continuous. The false impression of stall may have arisen due to the discrepancies between the estimates from the 1998 and the 2003 surveys, as shown in Figure 2.3.1 in Appendix 2. The estimate of partial TFR in 1996 from the 1998 survey was 0.8 lower than the estimate from the 2003 survey. In contrast, Kenya clearly decelerated in the pace of fertility decline after 1996, and the decline levelled off at a partial TFR of 4.5. Since Kenya has very good agreement in the estimates across the surveys, the observed stall in fertility decline is likely to be valid.

Second, the results clearly illustrate age displacement of children across the boundary year of eligibility for the additional survey questions on child health. The rate in the earliest year of a window dropped sharply, and the estimate of a year before the window was grossly inflated. In Uganda, for instance, large spikes and deficits were found in the two years across the boundary year in each of three surveys (see Figure 2.8.1 in Appendix 2). The partial TFR in 2000 was 7.7 and dropped sharply by 2.0 children in the following year.

These displacements disappeared and the agreement in the estimates from the consecutive surveys became better in the adjusted trends, shown in the second graphs for each country. Uganda clearly showed better agreement, for instance, as the adjusted trends in Figure 2.8.2 show fewer fluctuations than unadjusted trends in Figure 2.8.1. These findings support the reliability of Pullum's model for estimating age displacement. Nevertheless, as mentioned earlier, displacements or omissions more than two years across the boundary year were not adjusted.

Third, most surveys showed higher estimates in later surveys compared with earlier surveys during the overlapping periods. This may be due to a combination of overstatement of births in the later surveys and understatement or omissions, particularly of deceased children, in the earlier surveys, or to either one of these misstatements. Another possible explanation of the discrepancies may be differences in sample compositions between surveys, resulting in different slopes and levels of fertility estimates in overlapping periods. The next sections will explore potential reasons for such discrepancies.

The same analysis of estimating partial TFRs was repeated for urban and rural areas, as shown in the third graph for each country. These estimates are not adjusted for age displacement. The patterns of decline were different across countries. The gaps between urban and rural areas have been widening in Benin, Cameroon, Nigeria, Tanzania, and Zambia. In Ghana and Uganda the differences widened and then have been constant since around 2000. In contrast, the gap has been constant in Kenya, although the difference has been slightly widening. Only in Rwanda has the gap narrowed and then recently become constant. Age displacement was more apparent in rural areas in all countries, and particularly in Ghana, Nigeria, Uganda, and Zambia.

Inter-survey Comparison: Women's Educational Attainment

This section explores possible explanations for the discrepancies in estimates derived from the data for two successive survey periods, mentioned earlier. Appendix 3 presents the proportions of women with secondary or higher education, by birth cohort and by survey. Generally, the proportions were fairly similar across surveys, which implies that the composition of women by educational levels was quite similar and comparable across the surveys. It is unlikely that these slight differences have greatly affected trends of the fertility declines.

However, Nigeria showed a clear difference across the surveys. Apparently, the 1999 survey contained higher proportions of educated woman in almost all birth cohorts. Birth cohort 1960-69 in the 1999 survey included about 31 percent of women with secondary or higher education, while the 1990 and 2003 surveys encompassed about 23 percent, although the difference was not significant. This difference may have led to lower estimates of partial TFRs in the 1999 survey, probably due to omissions of births in the recent period or displacement across the boundary year (National Population Commission [Nigeria] 2000).

Similarly, the 1970-79 birth cohort in the 2003 Ghana DHS survey contained a lower proportion of educated women. Although the difference was not statistically significant, it might contribute to the discrepancy in the estimates from the two surveys. The difference in the proportions of educated women in the youngest cohort in Kenya is presumably due to the increase in the number of women going on to higher levels of schooling between the survey periods.

Inter-survey Comparison: Average Parity

Appendix 4 shows average parity by birth cohort and by survey. Parities were remarkably similar across the successive surveys. For instance, in Kenya parity in 1998 and the estimates from the 2003 DHS survey have 0.1 or less differences among all birth cohorts. The composition of women in terms of average parity were fairly similar as well, and the small differences were unlikely to substantially affect estimation of fertility trends. Yet, in the 1999 Nigeria DHS all birth cohorts had lower parity than the estimates from two other surveys, probably reflecting substantial omissions of births in the 1999 survey.

DISCUSSION

This section discusses recent fertility decline over 15 years, allowing for the impact of the errors identified from the above results for each country. Table 2 presents the trend for each country, comparing the results from the prior studies.

Table 2: Summary results and comparison of literature on stalling fertility

Country/Period	Results	Bongaarts[1]	Garenne 2008	Schoumaker 2009
Benin				
2001-06	**Stall**	**Stall**	Decline	Early transition
Cameroon				
1998-04	Decline	**Stall**	Decline	Decline
Ghana				
1998-03	Decline	**Stall**	**Stall**	Decline
2003-08		Decline	-	-
Kenya				
1998-03	**Stall**	**Stall**	**Stall**	**Stall**
Nigeria				
1999-03	Decline	**Stall**	**Stall**	Early transition
2003-08			-	-
Rwanda				
2000-05	**Stall**	**Stall**	**Stall**	**Stall**[3]
2005-07/8[4]	-	Decline	-	-
Tanzania				
1999-04	Early-transition	**Stall**	**Stall**	Decline
Uganda				
1995-00/1	Early-transition	**Stall**	Decline	Pre-transition
2000/1-06			-	
Zambia				
1996-01/2	Decline	**Stall**	Decline	Decline
2001/2-08	**Stall**		-	-

- The latest DHS survey was not included for the study.

[1] Partial TFR (15-39) was used.

[2] The trends are determined using Bongaarts' method (Bongaarts 2008).

[3] Stall in Rwanda was less certain.

[4] The dataset for Rwanda interim DHS 2007/8 has not been released as of 31 May, 2010.

Benin displays a modest fertility decline since the late 1990s. However, the adjusted smoothed trends suggest that the average annual pace of decline fell from 0.08 children to 0.03 children per year in the recent inter-survey period, and the pace of fertility decline in urban area appears particularly to have slowed in recent years (see Appendix 5). Digit preference and age displacement of women and children were more significant in the 2006 survey than in earlier surveys.

Cameroon exhibits similar modest but continuous fertility decline in the last 20 years. The graphs clearly show underestimation of births during the window of the second-to-last survey. As described in the DHS reports, the underestimation of births apparently caused overestimation of the pace of fertility decline in the 1990s. The fertility decline in urban areas was more rapid than in rural areas.

Ghana's fertility transition is similar to the other two West African countries studied, but the pace of decline is markedly more rapid. The observed fertility stall between the 1998 and 2003 surveys is likely to be spurious, because the estimates from the two surveys are not quite the same. The reason for the discrepancy is not clear. One potential explanation is that the 2003 survey might include a slightly lower proportion of educated women than the survey before it, in 1998, although the differences were not significant. This may be because of use of different sampling frame. The 2003 survey used the 2000 census, while the 1984 census was used previously. Also, there may be underestimation or omission of births in the 1998 survey, or a combination of both the underestimation and overestimation in the 2003 survey in the overlapping period. The pace of fertility decline in urban areas might have been slowing since 2000.

Kenya clearly shows fertility stall, as several prior studies have suggested. As the estimates from successive surveys are in good agreement, except the first survey, the stall is evidently genuine. Both urban and rural areas have been experiencing stalls since around 1996.

The long-term trend in Nigeria is difficult to interpret because of the poor data quality. As discussed earlier, the 1999 survey reported extensive omission of births (National Population Commission [Nigeria] 2000). There are also substantial discrepancies between the 1999 and 2003 surveys in partial TFR estimates and the average parity by birth cohort, as shown earlier. But the overall smoothed trends indicate modest fertility decline over the years.

The partial TFRs (15-39) in Rwanda have stabilized at around five children per woman in the past 15 years. The adjusted estimates suggest that the average pace of decline fell from 0.06 to 0.02 children (see Appendix 5). It is consistent with the 2005 Rwanda DHS report indicating that the TFR (15-49) remained at around six children per woman since 1990. No obvious explanation for the drop in partial TFR in 1998 can be offered. Despite little change in fertility in the past, the 2007-08 Rwanda Interim DHS report indicates a decrease in TFR from 6.2 to 5.5 at the national level since the previous survey in 2005.[8]

Tanzania, Uganda, and Zambia show similar patterns. National and rural partial TFRs fluctuated above five children per woman and show little decline over the past 20 years, as described in the DHS reports. In Uganda and Zambia, despite a large age displacement of children, these errors did not seriously affect patterns of the long-term trends. Further examination is needed in the next Tanzania and Zambia surveys to validate a slight upward trend in fertility, as observed in the DHS report and in this paper. In Uganda and Zambia the urban areas showed clear fertility declines, reaching a partial TFR of 4.0, while the published TFRs in urban areas appeared to stall between two latest surveys.

[8] The dataset had not been released as of the end of June, 2010.

CONCLUSIONS

This report began by proposing a hypothesis that the recent findings of fertility stalls in sub-Saharan Africa may be overstated, because they did not account adequately for limitations of DHS data quality. Our report assessed age and date misreporting in the surveys and their effects on estimation of recent fertility declines. We then estimated annual fertility rates, adjusting for misreporting in nine sub-Saharan countries where national TFRs appear to have failed to decline between successive DHS surveys around 2000.

The results suggest that some of the apparent fertility stalls observed earlier were exaggerated due to discrepancies in estimates between successive surveys in the late 1990s and early 2000s. The differences are likely to have resulted from age displacement, omissions of children, or different composition of women respondents across the successive surveys.

The partial TFRs by single calendar year showed clear evidence of fertility stall in Kenya, following a rapid fertility decline. Additionally, adjusted smoothed estimates suggests that TFRs in Benin, Rwanda, and Zambia declined little in recent years and remained constant at above five children per woman, despite the fact that these countries are considered to have started fertility transitions. These plateaus in fertility levels and the slow pace of decline at such levels are alarming.

The main conclusion drawn here is at variance with earlier findings by Bongaarts suggesting that fertility declines stalled in all the selected countries (Bongaarts 2006). The different results probably reflect differences in methods of assessing the pace of fertility decline and in consideration of the nature and quality of survey data used in the estimates. Our findings demonstrate that the levels of the error were not negligible and that these errors clearly distorted recent fertility trends in several surveys. Nonetheless, fertility decline appears clearly to have stalled in Kenya and is declining very slowly in the region as a whole, as suggested by earlier research (Bongaarts 2002; Casterline 2001).

A limitation of our study is that only the countries where fertility levelled off between two DHS surveys around 2000 were selected for analysis. Also, interpretation of fertility rates for about five years preceding the last survey needs some care, because the estimates can be affected by the errors but there is no new survey to validate the trends. Moreover, adjustment of

age displacement of children for partial TFRs were made for only two years across the boundary year, while children transferred more than two years across the boundary year could not be displaced back.

This study leads to three sets of recommendations for data collection, data analysis, and family planning programs. First, it is crucial to maintain a high quality of DHS data, particularly the quality of key indicators, such as fertility rates. The DHS has provided the highest quality of nationally representative demographic and health data in developing countries for over 25 years. Nonetheless, some errors cannot be avoided in this type of cross-sectional national household survey. This paper suggests the importance of balancing the length of the survey questionnaire with the need to ensure data quality, as the demand of information on maternal and child health increases. Also, strengthening supervision of fieldwork may be needed to ensure the accuracy of surveys. It is noteworthy that the level of age displacement of children is much lower in DHS surveys in Lesotho, where supervision was strongly performed by Ministry of Health and Social Welfare and Bureau of Statistics (Ministry of Health and Social Welfare (MOHSW) [Lesotho], Bureau of Statistics (BOS) [Lesotho] and ORC Macro 2005).

Second, data assessment of fertility estimates across successive surveys is crucial for examining fertility trends and for making good policy and program decisions based on observed trends. More accurate estimates allowing for errors inherent in survey taking can help policymakers and program leaders to set priorities and to evaluate family planning programs appropriately.

Third, fertility in Benin, Nigeria, Rwanda, Tanzania, Uganda, and Zambia remains quite high, particularly in the rural areas. In these and other sub-Saharan countries, there is an urgent need to understand the determinants of persistently high fertility and to provide appropriate family planning programs that meet the needs of the people.

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APPENDIX 1: AGE AND DATE MISREPORTING

Table1.1: Age and Date Misreporting in 9 sub-Saharan African countries

		Incompleteness of birth dates		Digit preference/Age heaping	Age displacement of women: Estimated % of women displaced		Age displacement of children: Estimated % of births in boundary year misreported in preceding year		
Country/ Year of Survey	Phase	Women's birth dates(%)	Children's birth dates(%)	Myer's blended Index for women	Women 15-19	Women 45-49	Alive children	Dead children	All children
Benin									
1996	3	78.3	41.5	5.9	11.2	6.6	1.7	11.3	3.4
2001	4	73.2	39.0	14.2	7.7	12.6	6.7	21.7	9.3
2006	5	62.6	13.5	17.8	13.7	15.6	17.3	30.2	19.1
Cameroon									
1991	2	50.9	30.7	8.5	4.7	27.3	7.8	18.7	9.3
1998	3	36.6	5.8	7.1	5.8	8.8	8.5	19.3	9.8
2004	4	30.7	6.3	5.8	1.4	11.6	5.7	17.0	7.5
Ghana									
1988	1	51.3	20.6	13.1	na	na	-1.3	-9.1	-2.2
1993	3	45.9	17.8	10.2	17.8	20.6	24.0	16.8	23.4
1998	4	36.7	13.3	9.5	14.1	6.0	7.2	19.2	8.7
2003	4	30.8	2.3	5.2	9.5	11.5	11.2	38.4	14.1
2008	5	21.2	4.0	7.4	4.8	9.3	17.3	19.5	17.5
Kenya									
1989	1	37.0	2.8	6.7	na	na	17.8	30.2	18.9
1993	3	34.3	8.3	7.6	16.1	28.5	7.7	19.2	8.7
1998	3	27.6	2.1	5.3	13.3	15.9	5.4	17.9	6.5
2003	4	26.7	4.8	4.8	6.9	14.0	3.8	7.2	4.2
Nigeria									
1990	2	44.7	16.6	26.1	19.7	28.8	15.9	32.5	19.3
1999	4	36.2	16.1	19.2	-17.4	17.9	8.4	16.8	9.5
2003	4	23.9	8.4	15.7	1.2	14.1	-2.2	6.8	-0.1
2008	5	24.8	2.7	16.8	4.7	9.0	9.8	28.6	13.0
Rwanda									
1992	2	61.6	6.6	5.7	5.3	14.7	0.0	11.7	1.9
2000	3	46.9	4.4	6.3	10.0	2.7	11.5	31.6	15.7
2005	5	54.0	1.1	5.3	3.6	6.1	1.1	2.8	1.3
Tanzania									
1991/92	2	57.4	16.7	5.1	5.1	10.8	3.8	30.0	8.1
1996	3	40.4	6.7	5.9	9.9	6.2	9.4	25.8	11.8
1999	4	35.7	2.9	4.1	3.7	3.1	2.4	3.8	2.6
2004/05	4	26.6	1.6	5.5	6.9	2.4	-0.2	33.6	4.1
Uganda									
1995	3	44.1	6.1	7.7	10.3	31.3	15.8	25.3	17.3
2000/01	4	41.6	5.4	7.5	12.0	15.5	13.0	21.0	14.1
2006	5	36.8	2.7	5.5	14.3	7.5	11.7	22.0	13.5
Zambia									
1992	2	11.8	1.8	4.8	-1.3	17.3	4.1	7.2	4.7
1996	3	18.7	1.0	5.2	6.7	7.4	10.2	24.9	13.1
2001/02	4	16.4	1.5	3.2	5.2	5.8	8.8	13.1	9.5
2007	5	8.6	0.8	2.1	11.7	2.0	-1.6	-0.6	-1.6

APPENDIX 2: RECENT FERTILITY TRENDS BY SINGLE CALENDAR YEAR

Figure 2.1.1: Benin: Partial Total Fertility Rates (15-39) by single calendar year

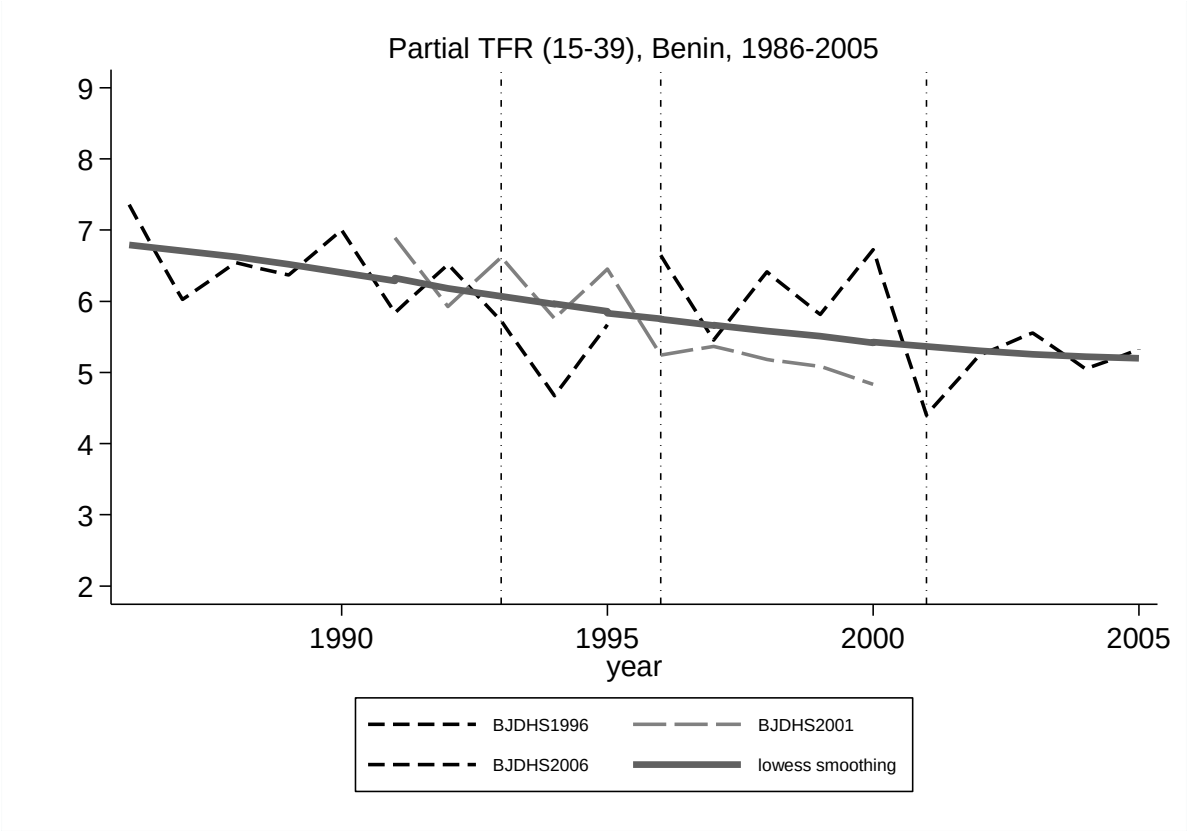

Figure 2.1.2: Benin: Adjusted partial Total Fertility Rates (15-39) by single calendar year

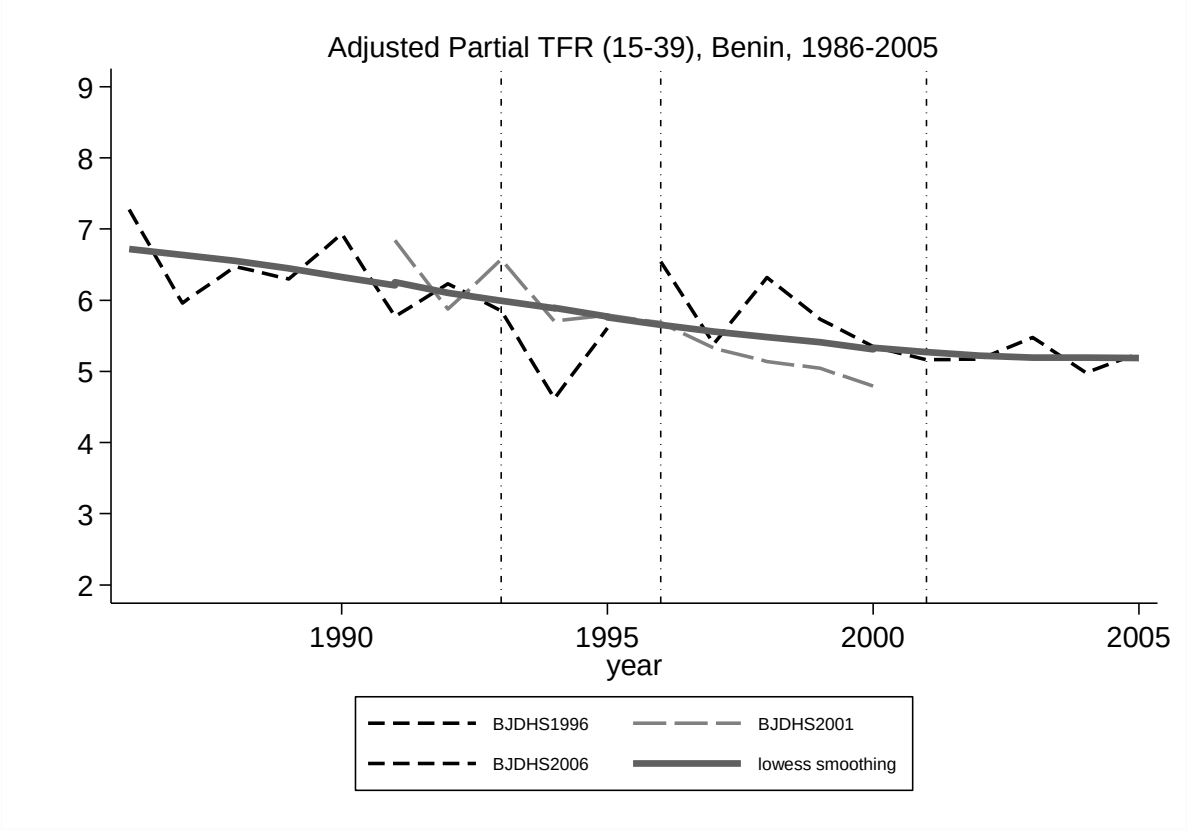

Figure 2.1.3: Benin: Partial Total Fertility Rates (15-39) by single calendar year by residence

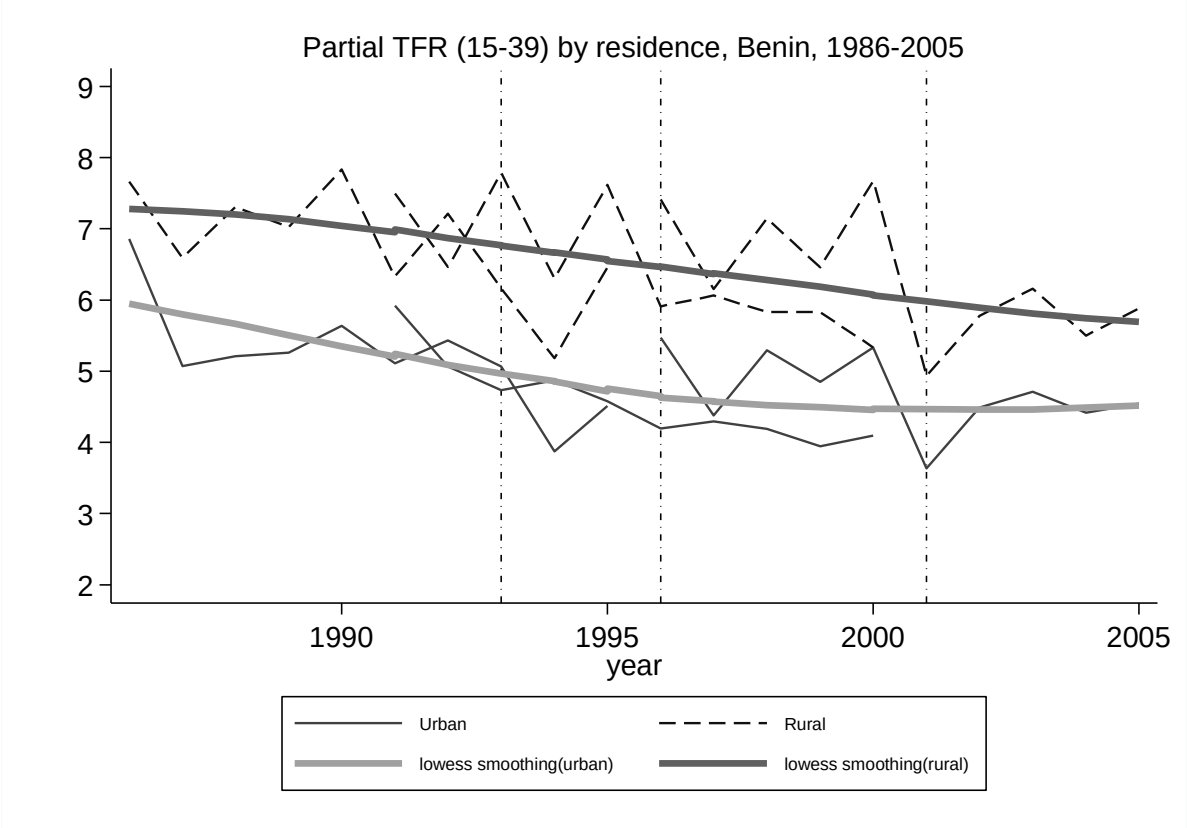

Table 2.1: Benin: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI] 1996	2001	2006	Adjusted smoothed TFR (15-39)
1986	7.4 (6.94 - 7.77)			6.7
1987	6.0 (5.61 - 6.44)			6.6
1988	6.5 (6.09 - 6.99)			6.6
1989	6.4 (5.96 - 6.78)			6.4
1990	7.0 (6.54 - 7.46)	6.1 (5.61 - 6.51)		6.3
1991	5.8 (5.46 - 6.22)	6.9 (6.43 - 7.36)		6.2
1992	6.5 (6.12 - 6.92)	5.9 (5.51 - 6.34)		6.1
1993	5.7 (5.32 - 6.13)	6.6 (6.15 - 7.09)		6.0
1994	4.7 (4.32 - 5.02)	5.8 (5.37 - 6.15)		5.9
1995	5.7 (5.28 - 6.07)	6.5 (5.96 - 6.94)	5.3 (5.06 - 5.59)	5.8
1996		5.2 (4.87 - 5.62)	6.6 (6.39 - 6.90)	5.7
1997		5.4 (5.03 - 5.71)	5.5 (5.22 - 5.69)	5.6
1998		5.2 (4.84 - 5.52)	6.4 (6.15 - 6.67)	5.5
1999		5.1 (4.77 - 5.40)	5.8 (5.57 - 6.06)	5.4
2000		4.8 (4.50 - 5.16)	6.7 (6.44 - 7.01)	5.3
2001			4.4 (4.20 - 4.60)	5.3
2002			5.2 (5.04 - 5.45)	5.2
2003			5.6 (5.34 - 5.77)	5.2
2004			5.0 (4.85 - 5.25)	5.2
2005			5.3 (5.13 - 5.52)	5.2

Figure 2.2.1: Cameroon: Partial Total Fertility Rates (15-39) by single calendar year

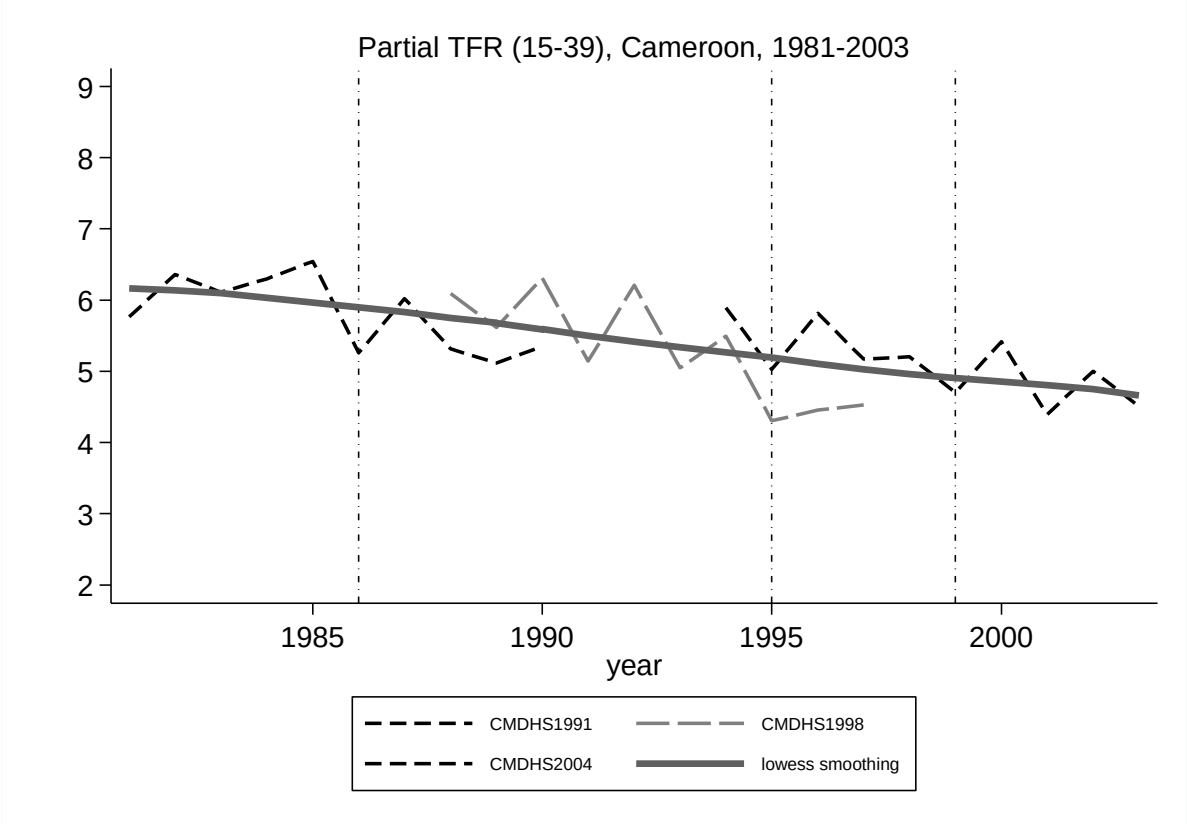

Figure 2.2.2: Cameroon: Adjusted partial Total Fertility Rates (15-39) by single calendar year

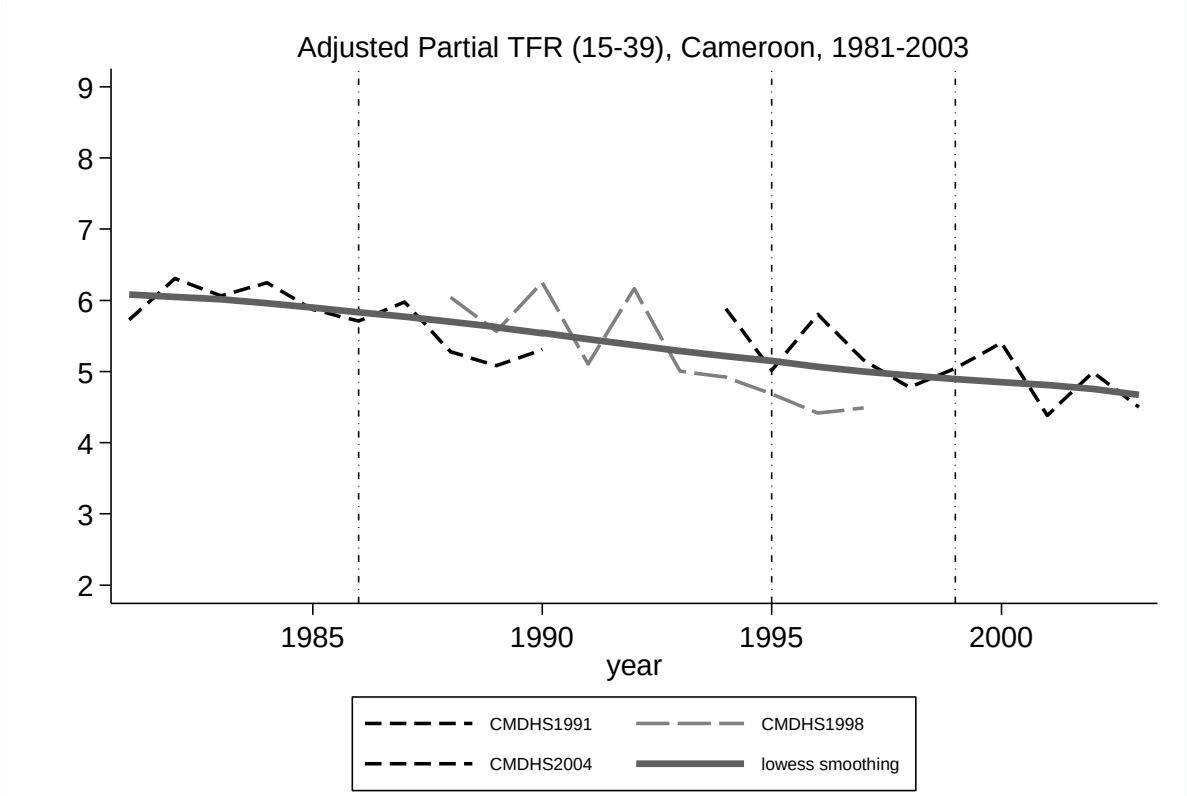

Figure 2.2.3: Cameroon: Partial Total Fertility Rates (15-39) by single calendar year by residence

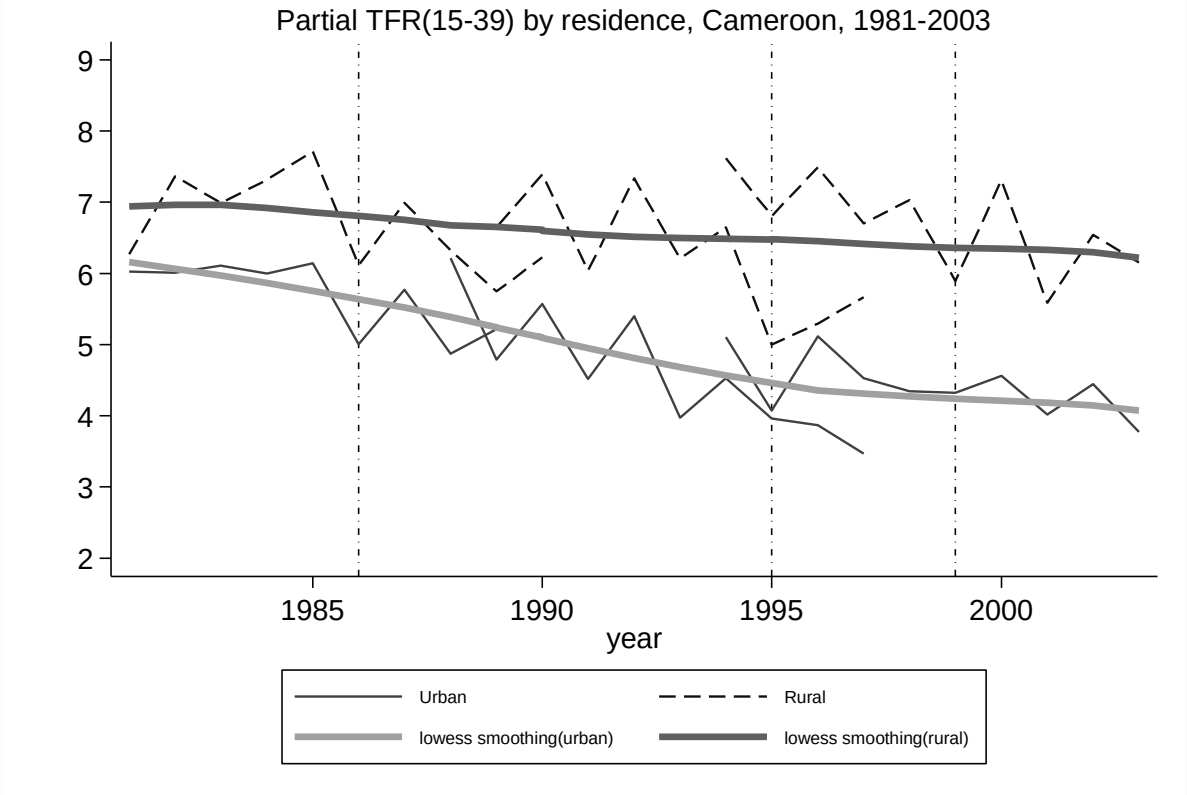

Table 2.2: Cameroon: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI] 1991	1998	2004	Adjusted smoothed TFR (15-39)
1981	5.8 (5.17 - 6.35)			6.1
1982	6.4 (5.78 - 6.94)			6.0
1983	6.1 (5.62 - 6.60)			6.0
1984	6.3 (5.67 - 6.93)			6.0
1985	6.5 (6.04 - 7.04)			5.9
1986	5.3 (4.74 - 5.78)			5.8
1987	6.0 (5.57 - 6.48)	6.0 (5.44 - 6.55)		5.8
1988	5.3 (4.91 - 5.72)	6.1 (5.68 - 6.51)		5.7
1989	5.1 (4.75 - 5.49)	5.6 (5.17 - 6.06)		5.6
1990	5.3 (4.91 - 5.79)	6.3 (5.86 - 6.76)		5.5
1991		5.1 (4.70 - 5.58)		5.5
1992		6.2 (5.79 - 6.63)		5.4
1993		5.0 (4.64 - 5.46)	5.3 (4.96 - 5.63)	5.3
1994		5.5 (5.05 - 5.94)	5.9 (5.51 - 6.28)	5.2
1995		4.3 (3.89 - 4.72)	5.0 (4.70 - 5.36)	5.1
1996		4.5 (4.07 - 4.84)	5.8 (5.47 - 6.16)	5.1
1997		4.5 (4.14 - 4.92)	5.2 (4.84 - 5.50)	5.0
1998			5.2 (4.90 - 5.51)	4.9
1999			4.7 (4.41 - 5.00)	4.9
2000			5.4 (5.12 - 5.71)	4.9
2001			4.4 (4.11 - 4.67)	4.8
2002			5.0 (4.72 - 5.28)	4.8
2003			4.5 (4.23 - 4.80)	4.7

Figure 2.3.1: Ghana: Partial Total Fertility Rates (15-39) by single calendar year

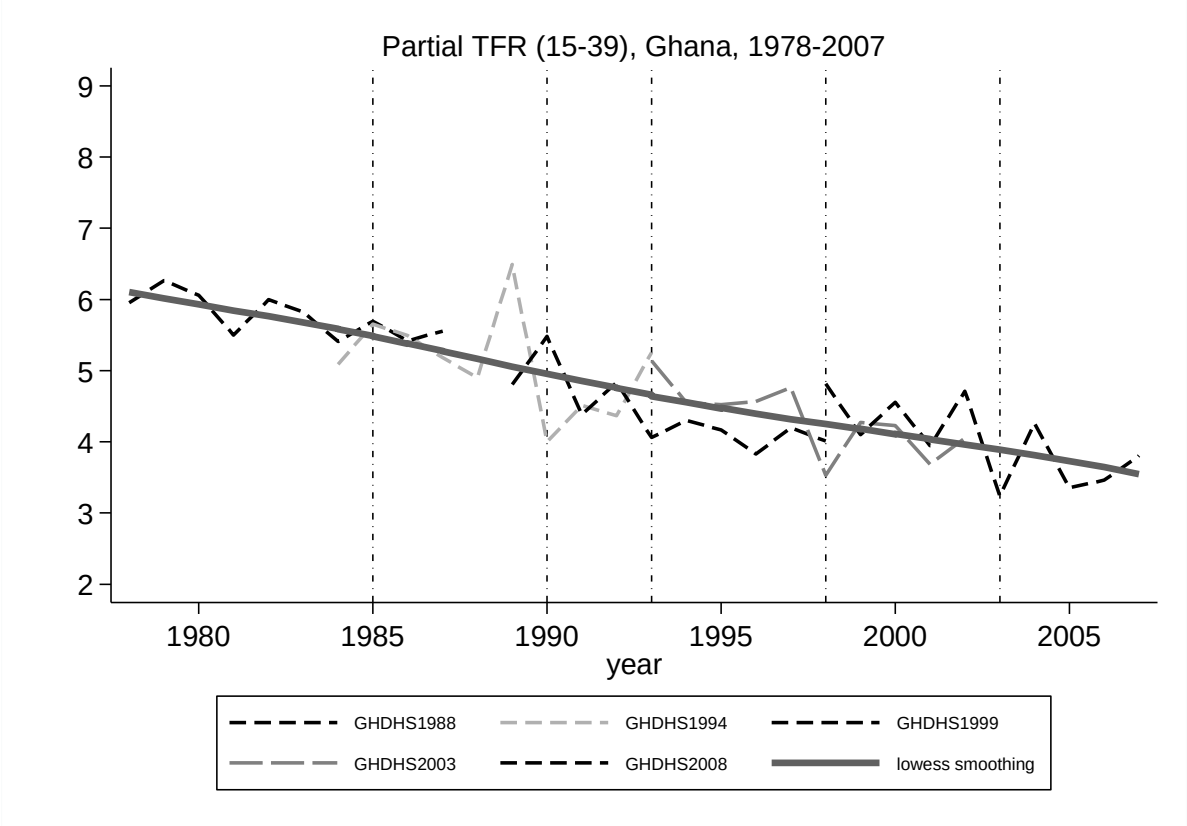

Figure 2.3.2: Ghana: Adjusted partial Total Fertility Rates (15-39) by single calendar year

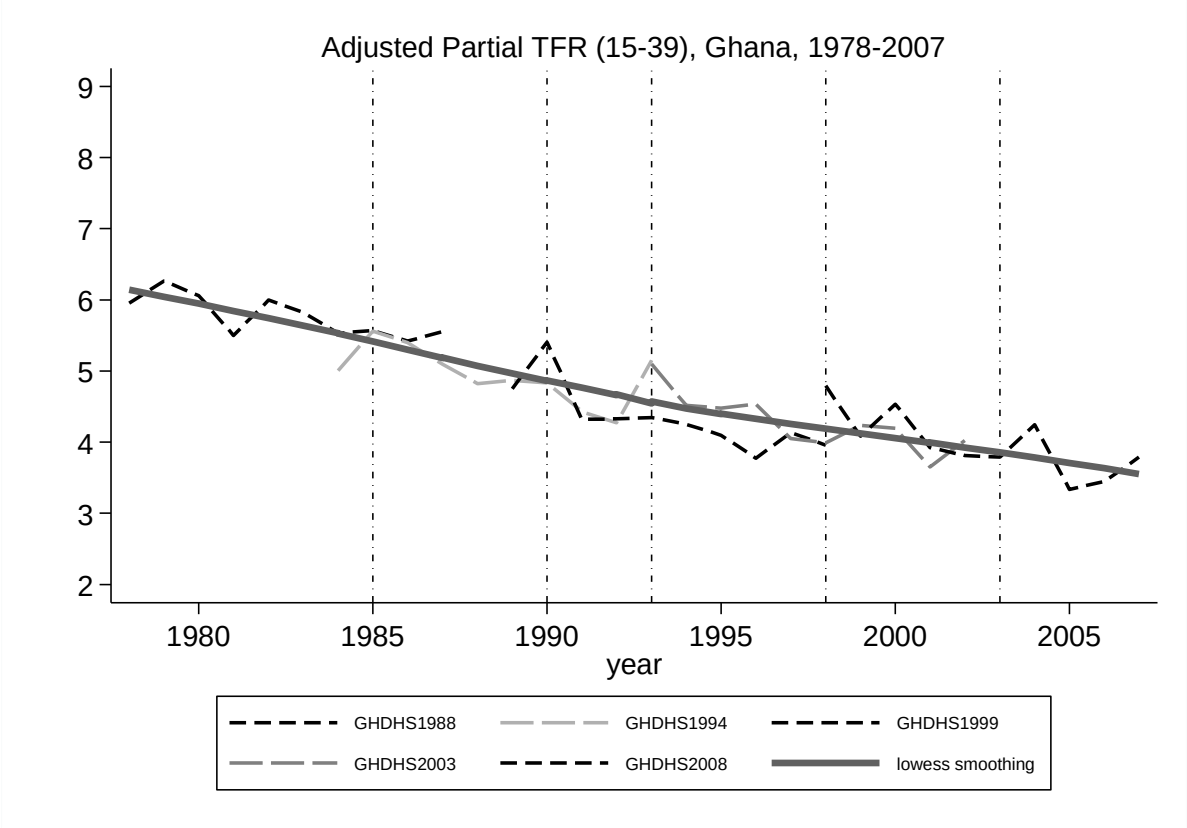

Figure 2.3.3: Ghana: Partial Total Fertility Rates (15-39) by single calendar year by residence

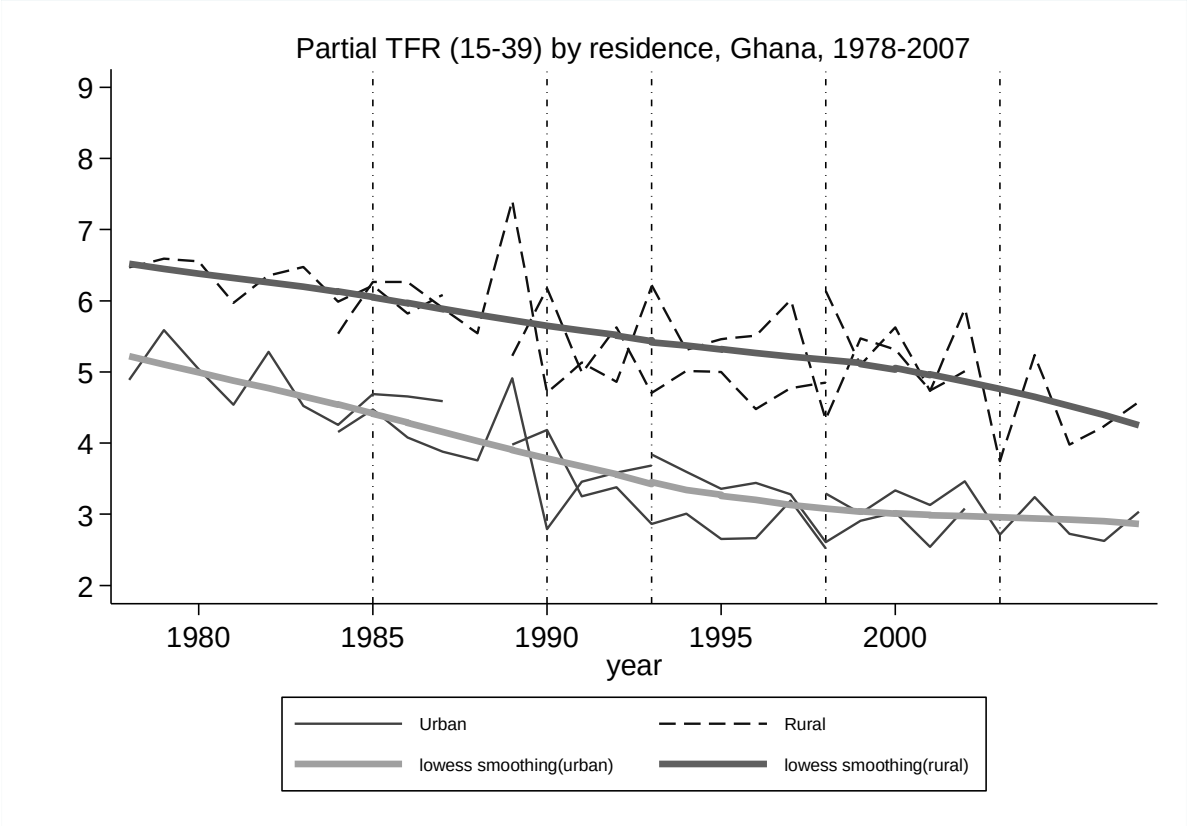

Table 2.3: Ghana: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI] 1988	1993	1998	2003	2008	Adjusted smoothed TFR (15-39)
1979	6.3 (5.80 - 6.72)					6.0
1980	6.1 (5.61 - 6.51)					5.9
1981	5.5 (5.09 - 5.91)					5.8
1982	6.0 (5.57 - 6.43)					5.7
1983	5.8 (5.41 - 6.23)					5.6
1984	5.4 (4.98 - 5.84)	5.1 (4.70 - 5.48)				5.5
1985	5.7 (5.26 - 6.13)	5.7 (5.23 - 6.08)				5.4
1986	5.4 (5.03 - 5.81)	5.5 (5.07 - 5.91)				5.3
1987	5.6 (5.18 - 5.93)	5.2 (4.78 - 5.58)				5.2
1988		4.9 (4.55 - 5.25)				5.1
1989		6.5 (6.07 - 6.92)	4.8 (4.43 - 5.19)			5.0
1990		4.0 (3.68 - 4.32)	5.5 (5.07 - 5.89)			4.9
1991		4.5 (4.17 - 4.85)	4.4 (4.00 - 4.76)			4.8
1992		4.4 (4.03 - 4.70)	4.8 (4.42 - 5.25)			4.7
1993			4.1 (3.73 - 4.39)	5.1 (4.74 - 5.54)		4.6
1994			4.3 (3.95 - 4.65)	4.6 (4.18 - 4.92)		4.5
1995			4.2 (3.79 - 4.54)	4.5 (4.14 - 4.91)		4.4
1996			3.8 (3.49 - 4.17)	4.6 (4.18 - 4.96)		4.3
1997			4.2 (3.85 - 4.55)	4.8 (4.38 - 5.15)	3.6 (3.24 - 4.03)	4.3
1998				3.5 (3.23 - 3.84)	4.8 (4.36 - 5.28)	4.2
1999				4.3 (3.92 - 4.62)	4.1 (3.70 - 4.50)	4.1
2000				4.2 (3.90 - 4.55)	4.6 (4.16 - 4.96)	4.1
2001				3.7 (3.35 - 4.02)	3.9 (3.56 - 4.32)	4.0
2002				4.1 (3.71 - 4.40)	4.7 (4.30 - 5.13)	3.9
2003					3.2 (2.94 - 3.54)	3.9
2004					4.3 (3.86 - 4.66)	3.8
2005					3.4 (3.02 - 3.69)	3.7
2006					3.5 (3.13 - 3.79)	3.6
2007					3.8 (3.46 - 4.15)	3.6

Figure 2.4.1: Kenya: Partial Total Fertility Rates (15-39) by single calendar year

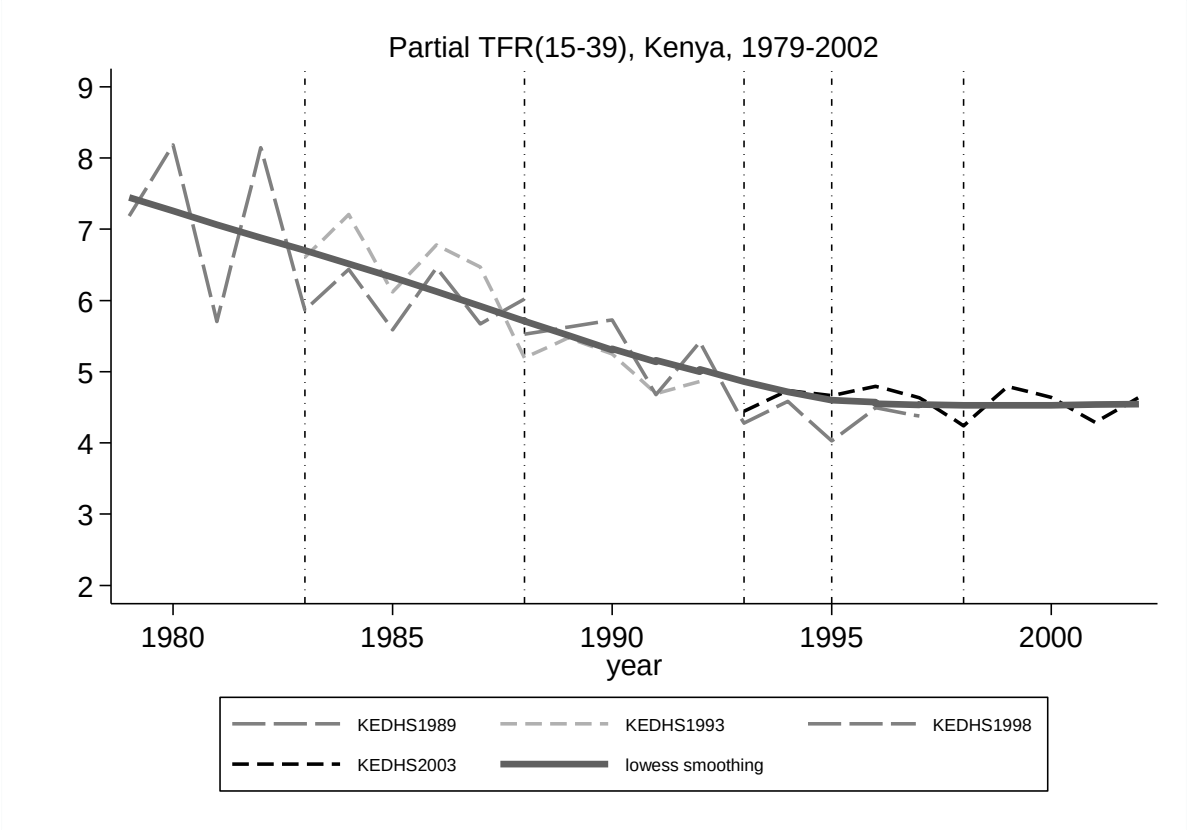

Figure 2.4.2: Kenya : Adjusted partial Total Fertility Rates (15-39) by single calendar year

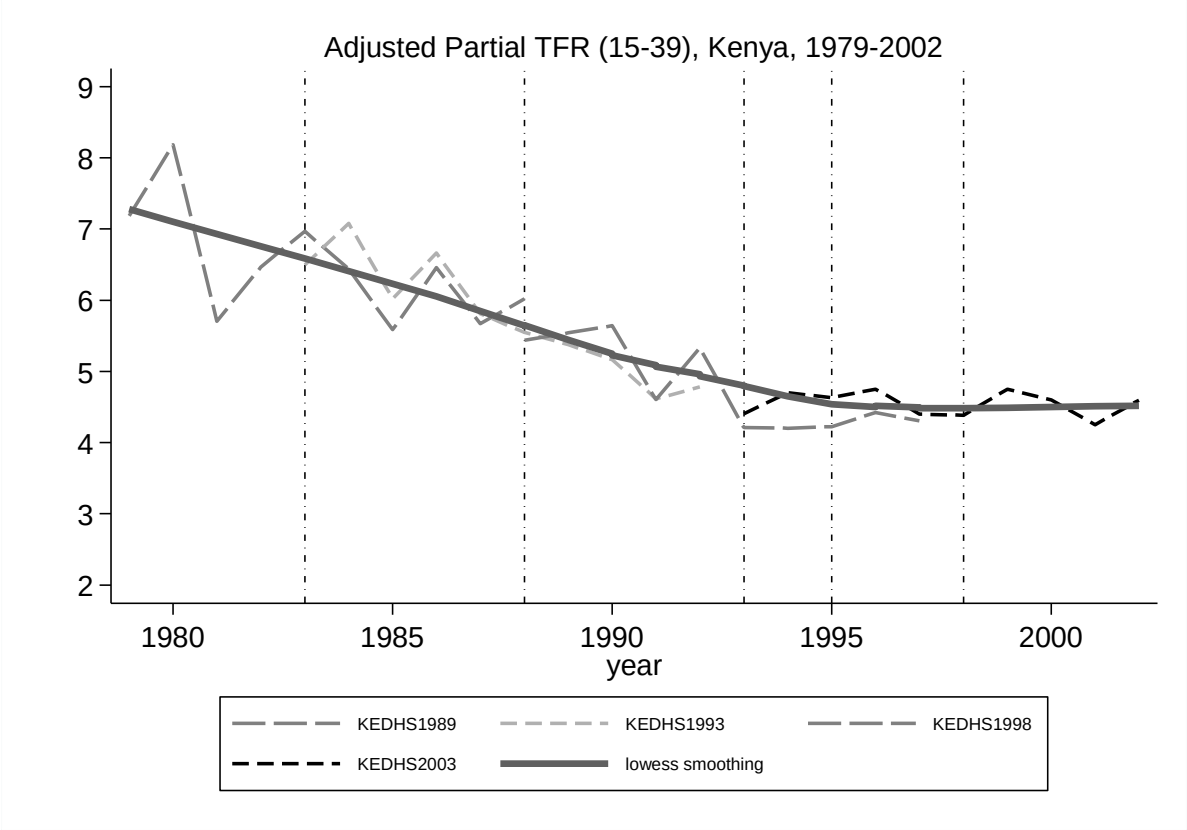

Figure 2.4.3: Kenya: Partial Total Fertility Rates (15-39) by single calendar year by residence

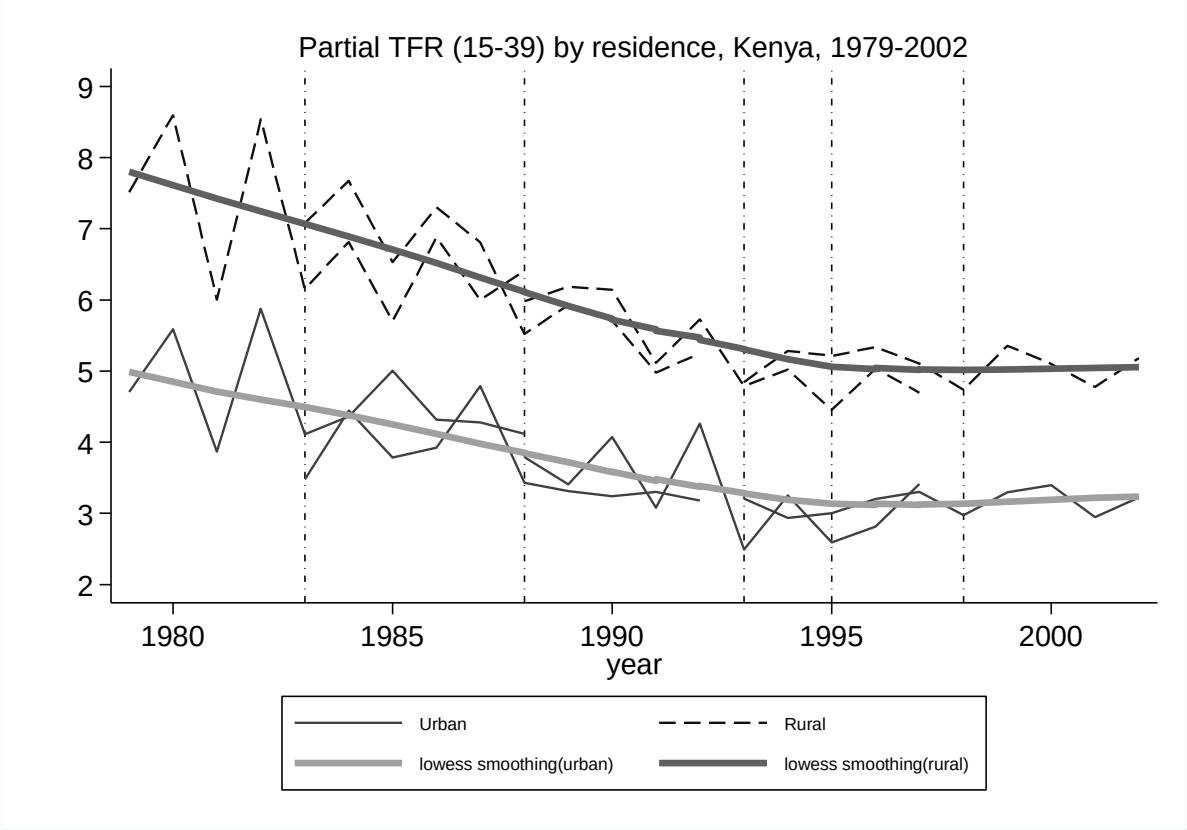

Table 2.4: Kenya: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI]				Adjusted smoothed TFR (15-39)
	1989	1993	1998	2003	
1980	8.2 (7.57 - 8.80)				7.1
1981	5.7 (5.22 - 6.19)				6.9
1982	8.1 (7.74 - 8.55)				6.8
1983	5.9 (5.40 - 6.33)	6.6 (6.12 - 7.09)			6.6
1984	6.4 (6.01 - 6.86)	7.2 (6.78 - 7.63)			6.4
1985	5.6 (5.16 - 6.01)	6.1 (5.70 - 6.54)			6.2
1986	6.5 (6.02 - 6.90)	6.8 (6.36 - 7.19)			6.1
1987	5.7 (5.30 - 6.05)	6.5 (6.10 - 6.84)			5.8
1988	6.0 (5.63 - 6.40)	5.2 (4.82 - 5.57)	5.5 (5.14 - 5.91)		5.6
1989		5.5 (5.12 - 5.83)	5.6 (5.24 - 6.01)		5.4
1990		5.3 (4.91 - 5.59)	5.7 (5.33 - 6.12)		5.2
1991		4.7 (4.40 - 4.99)	4.7 (4.34 - 5.02)		5.1
1992		4.9 (4.53 - 5.20)	5.4 (5.09 - 5.75)		4.9
1993			4.3 (3.95 - 4.61)	4.4 (4.09 - 4.81)	4.8
1994			4.6 (4.28 - 4.89)	4.7 (4.33 - 5.15)	4.7
1995			4.0 (3.73 - 4.33)	4.7 (4.30 - 5.03)	4.5
1996			4.5 (4.18 - 4.81)	4.8 (4.42 - 5.17)	4.5
1997			4.4 (4.09 - 4.66)	4.6 (4.28 - 4.99)	4.5
1998				4.2 (3.93 - 4.55)	4.5
1999				4.8 (4.43 - 5.15)	4.5
2000				4.6 (4.31 - 4.97)	4.5
2001				4.3 (3.94 - 4.63)	4.5
2002				4.6 (4.30 - 4.98)	4.5

Figure 2.5.1: Nigeria: Partial Total Fertility Rates (15-39) by single calendar year

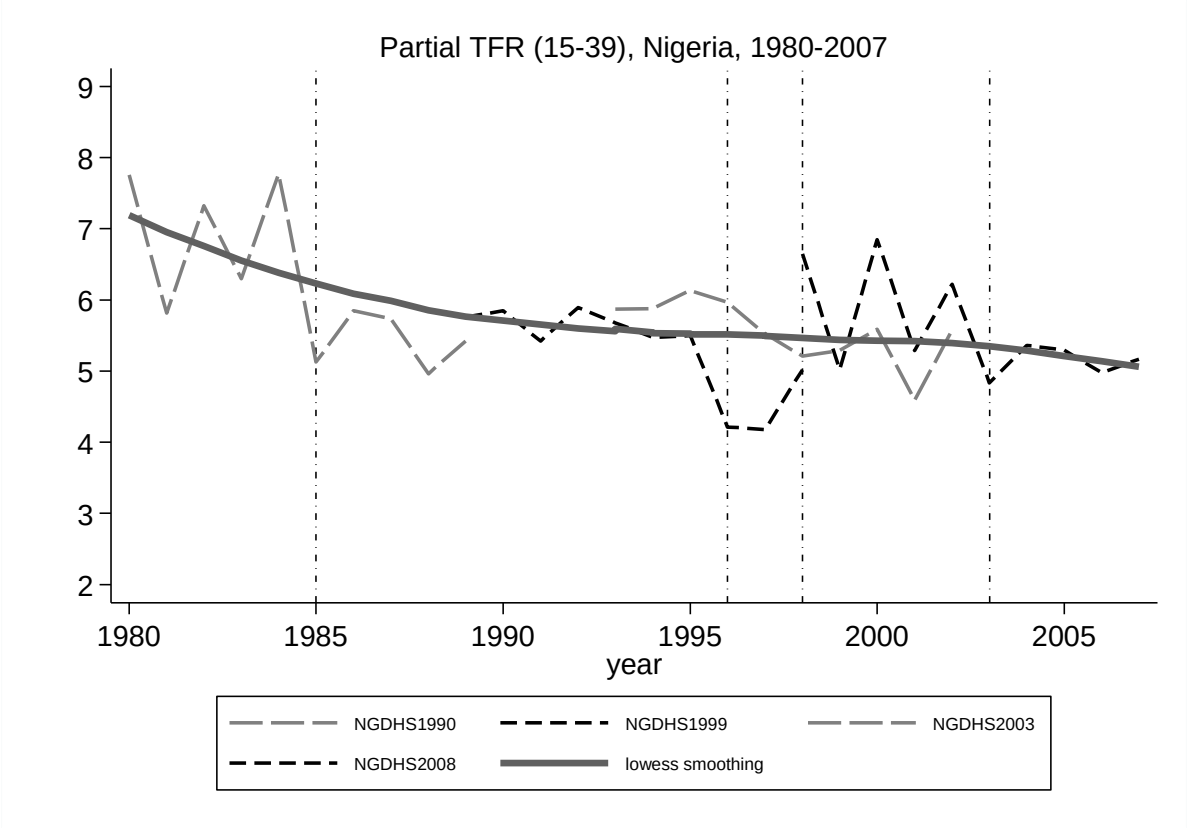

Figure 2.5.2: Nigeria: Adjusted partial Total Fertility Rates (15-39) by single calendar year

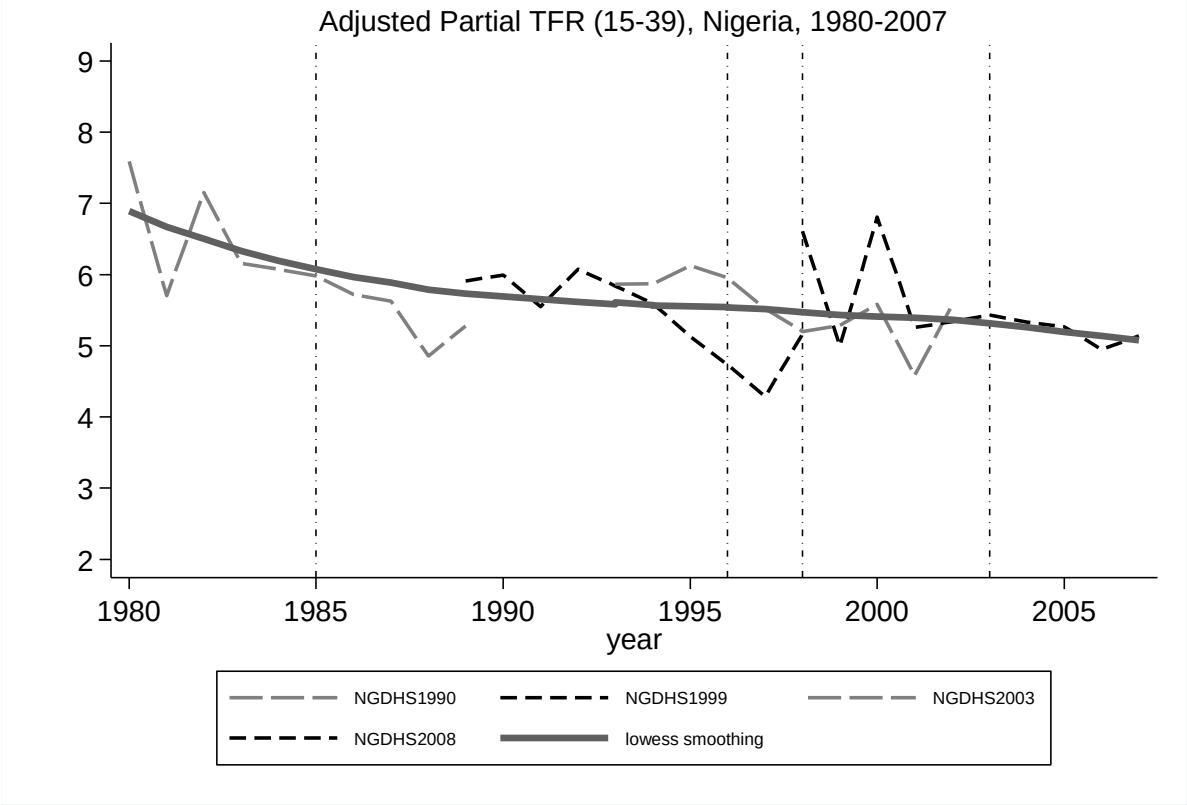

Figure 2.5.3: Nigeria: Partial Total Fertility Rates (15-39) by single calendar year by residence

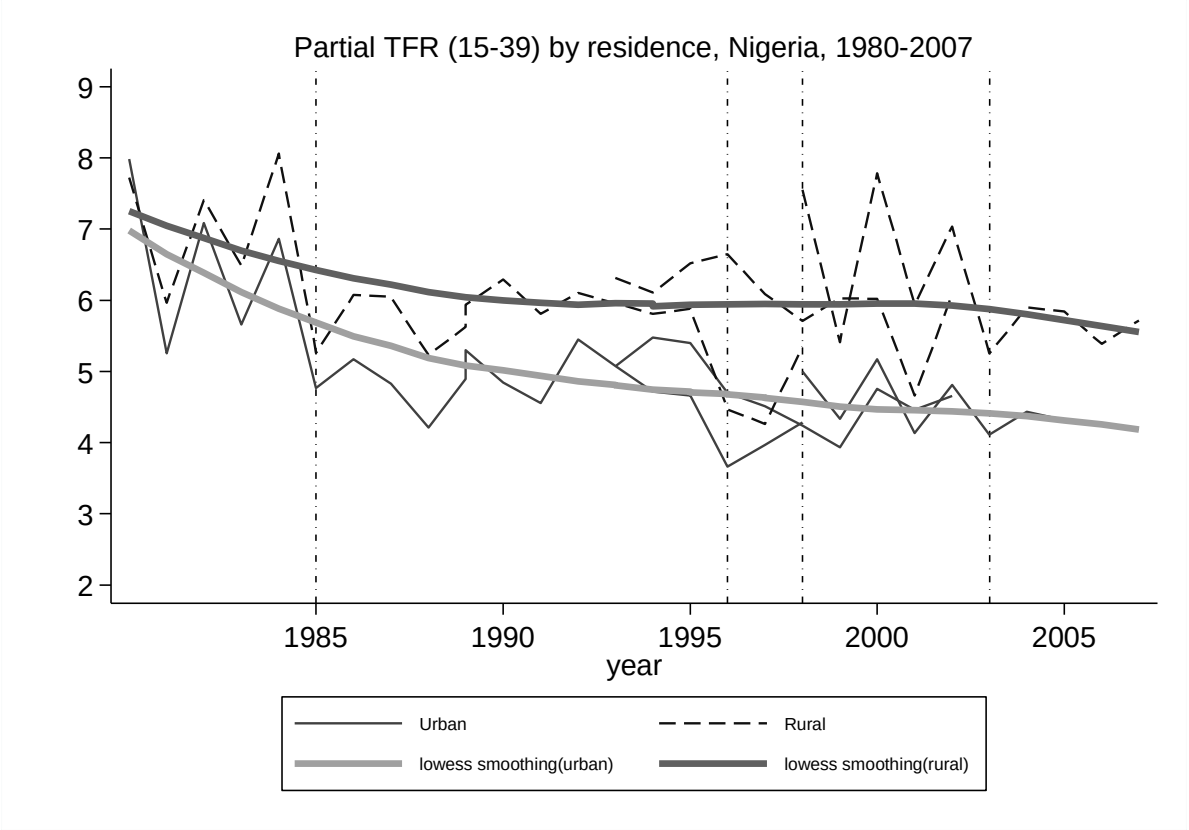

Table 2.5: Nigeria: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI] 1990	1999	2003	2008	Adjusted smoothed TFR (15-39)
1980	7.8 (7.29 - 8.22)				6.9
1981	5.8 (5.41 - 6.22)				6.7
1982	7.3 (6.75 - 7.90)				6.5
1983	6.3 (5.82 - 6.77)				6.3
1984	7.8 (7.29 - 8.26)				6.2
1985	5.1 (4.76 - 5.49)				6.1
1986	5.8 (5.43 - 6.27)				6.0
1987	5.7 (5.25 - 6.22)				5.9
1988	5.0 (4.54 - 5.39)				5.8
1989	5.4 (5.10 - 5.75)	5.8 (5.40 - 6.12)			5.7
1990		5.8 (5.48 - 6.22)			5.7
1991		5.4 (5.09 - 5.76)			5.7
1992		5.9 (5.53 - 6.26)			5.6
1993		5.7 (5.36 - 6.00)	5.9 (5.45 - 6.29)		5.6
1994		5.5 (5.17 - 5.78)	5.9 (5.44 - 6.31)		5.6
1995		5.5 (5.16 - 5.84)	6.1 (5.58 - 6.69)		5.6
1996		4.2 (3.92 - 4.50)	6.0 (5.52 - 6.41)		5.5
1997		4.2 (3.92 - 4.44)	5.5 (5.07 - 5.97)		5.5
1998		5.0 (4.69 - 5.35)	5.2 (4.76 - 5.66)	6.6 (6.41 - 6.89)	5.5
1999			5.3 (4.88 - 5.70)	5.0 (4.83 - 5.21)	5.4
2000			5.6 (5.16 - 6.02)	6.8 (6.59 - 7.11)	5.4
2001			4.6 (4.21 - 4.96)	5.3 (5.08 - 5.49)	5.4
2002			5.6 (5.10 - 6.06)	6.2 (5.99 - 6.45)	5.4
2003				4.8 (4.65 - 5.02)	5.3
2004				5.4 (5.17 - 5.55)	5.3
2005				5.3 (5.10 - 5.49)	5.2
2006				5.0 (4.80 - 5.15)	5.1
2007				5.2 (4.98 - 5.36)	5.1

Figure 2.6.1: Rwanda: Partial Total Fertility Rates (15-39) by single calendar year

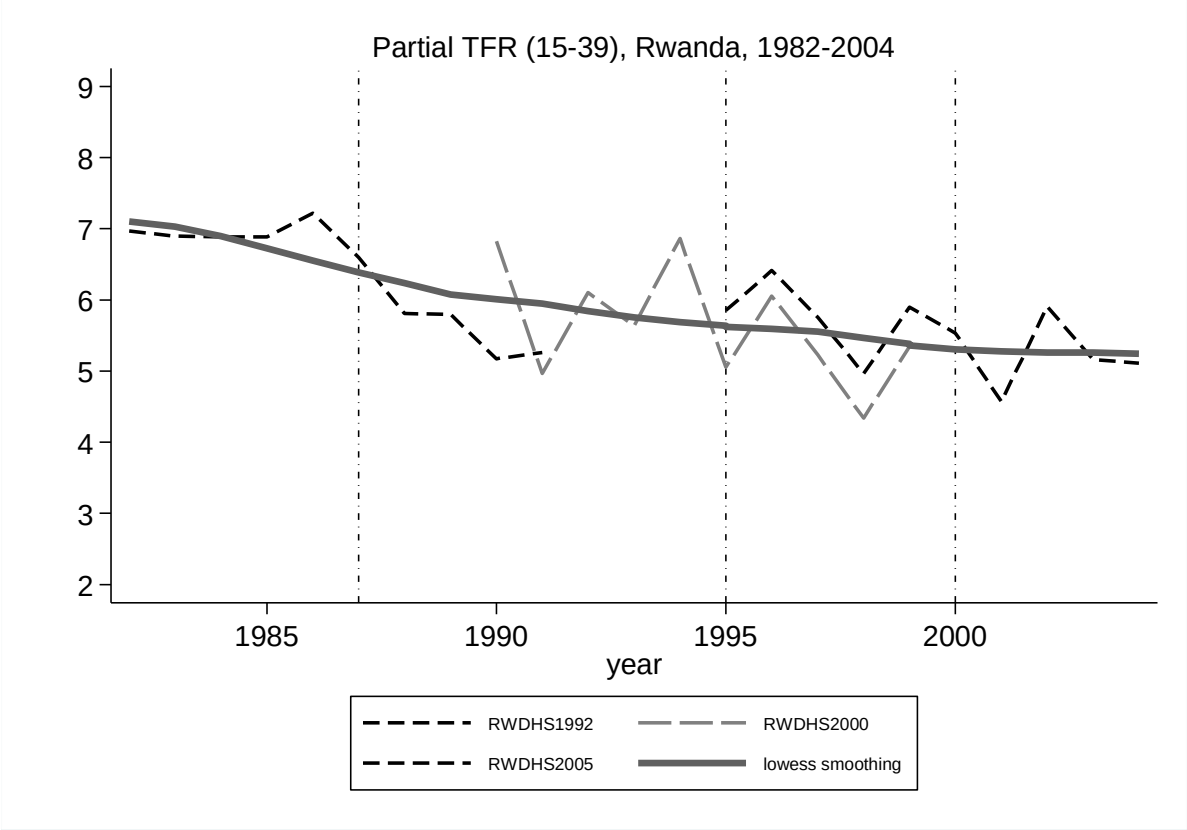

Figure 2.6.2: Rwanda: Adjusted partial Total Fertility Rates (15-39) by single calendar year

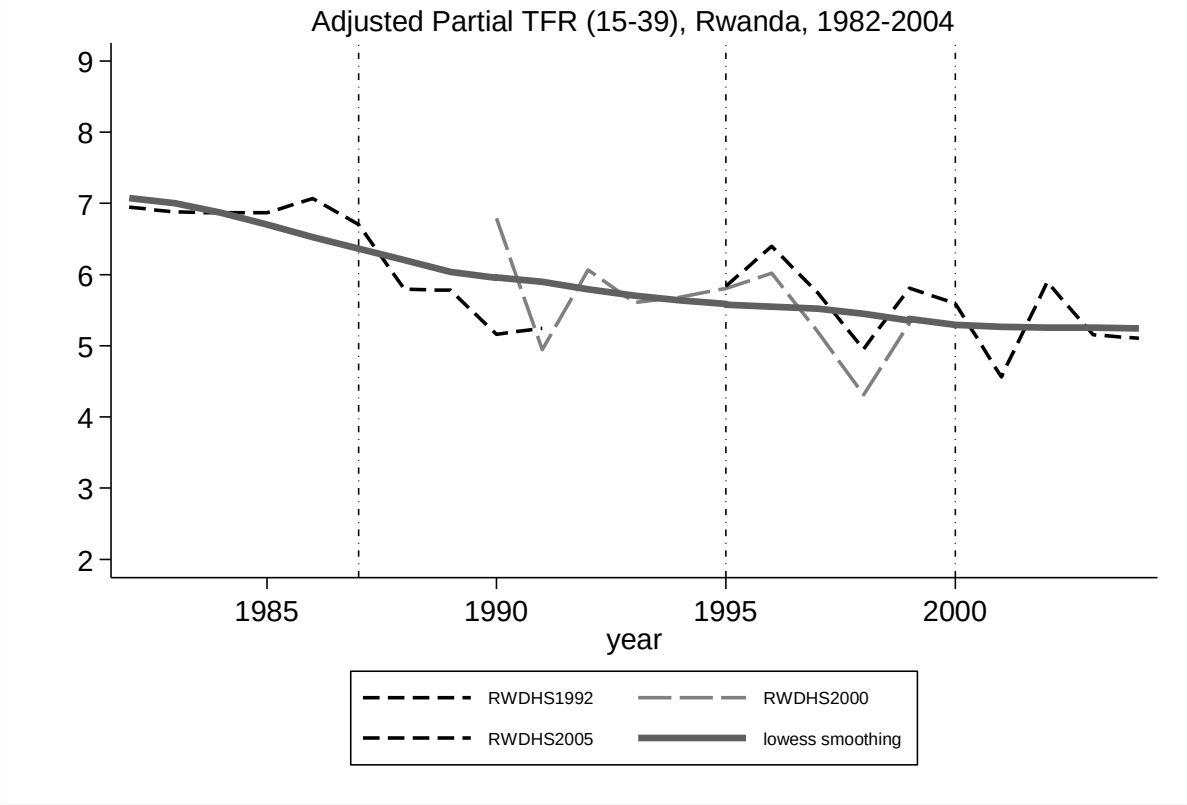

Figure 2.6.3: Rwanda: Partial Total Fertility Rates (15-39) by single calendar year by residence

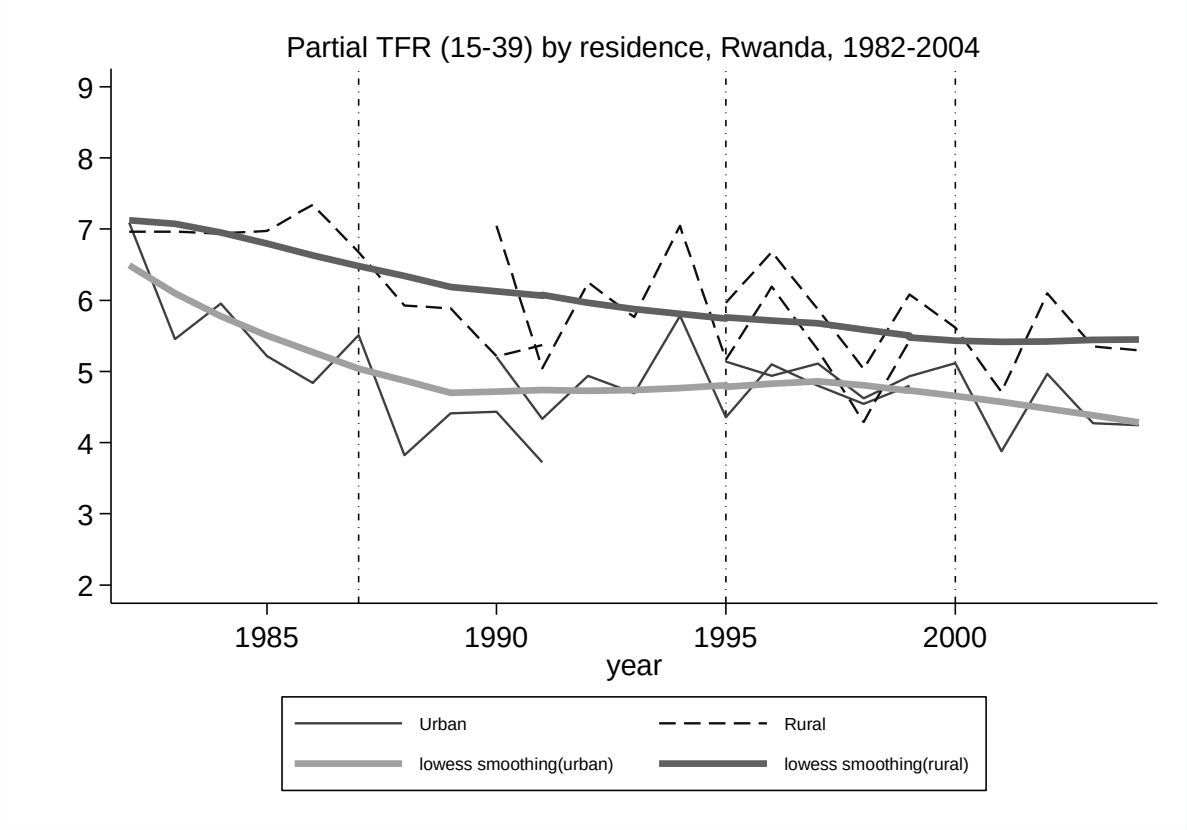

Table 2.6: Rwanda: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI]			Adjusted smoothed TFR (15-39)
	1992	2000	2005	
1982	7.0 (6.51 - 7.42)			7.1
1983	6.9 (6.47 - 7.32)			7.0
1984	6.9 (6.45 - 7.32)			6.9
1985	6.9 (6.49 - 7.28)			6.7
1986	7.2 (6.79 - 7.64)			6.5
1987	6.6 (6.24 - 6.96)			6.4
1988	5.8 (5.44 - 6.18)			6.2
1989	5.8 (5.42 - 6.17)			6.0
1990	5.2 (4.84 - 5.51)	6.8 (6.45 - 7.20)		6.0
1991	5.3 (4.92 - 5.60)	5.0 (4.65 - 5.28)		5.9
1992		6.1 (5.76 - 6.44)		5.8
1993		5.6 (5.34 - 5.94)		5.7
1994		6.9 (6.52 - 7.20)		5.6
1995		5.1 (4.79 - 5.32)	5.9 (5.54 - 6.16)	5.6
1996		6.1 (5.75 - 6.35)	6.4 (6.10 - 6.73)	5.5
1997		5.2 (4.98 - 5.47)	5.8 (5.46 - 6.05)	5.5
1998		4.3 (4.07 - 4.61)	5.0 (4.70 - 5.23)	5.5
1999		5.3 (5.04 - 5.64)	5.9 (5.59 - 6.21)	5.4
2000			5.5 (5.24 - 5.82)	5.3
2001			4.6 (4.33 - 4.81)	5.3
2002			5.9 (5.62 - 6.19)	5.3
2003			5.2 (4.92 - 5.40)	5.3
2004			5.1 (4.85 - 5.37)	5.2

Figure 2.7.1: Tanzania: Partial Total Fertility Rates (15-39) by single calendar year

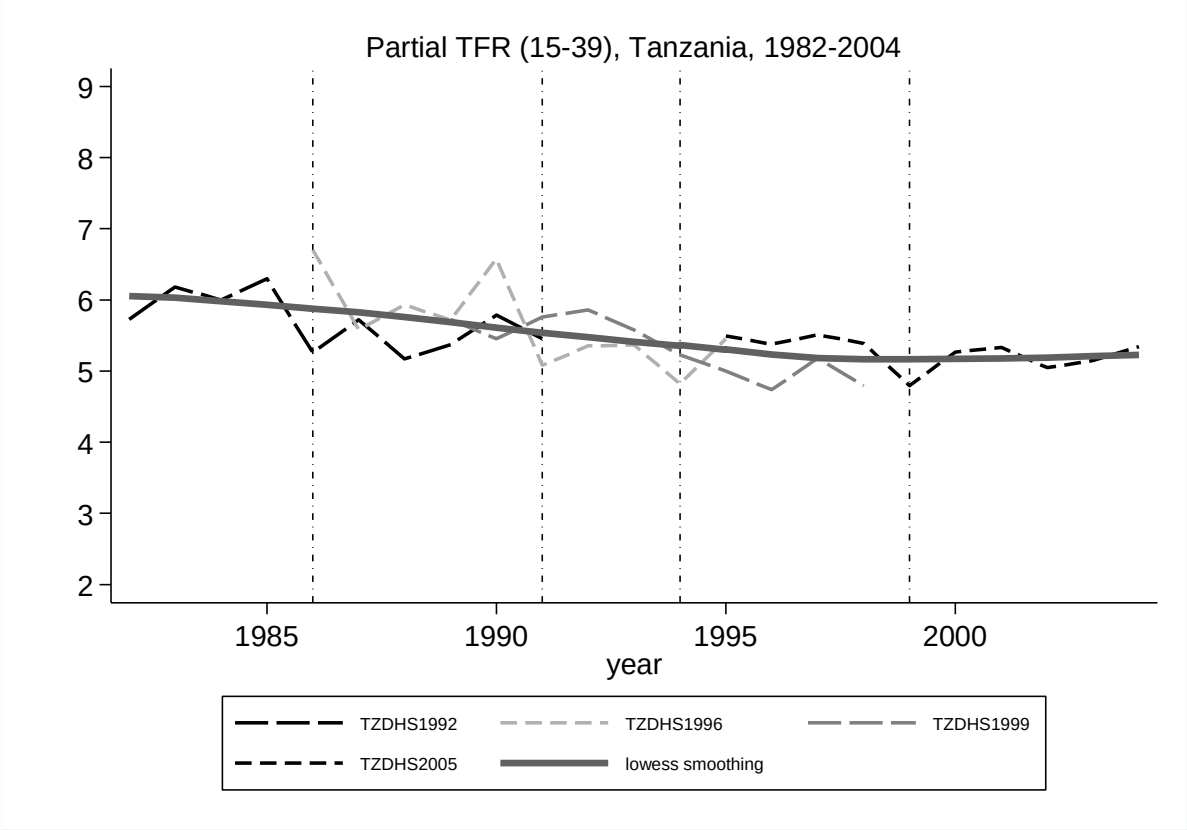

Figure 2.7.2: Tanzania: Adjusted partial Total Fertility Rates (15-39) by single calendar year

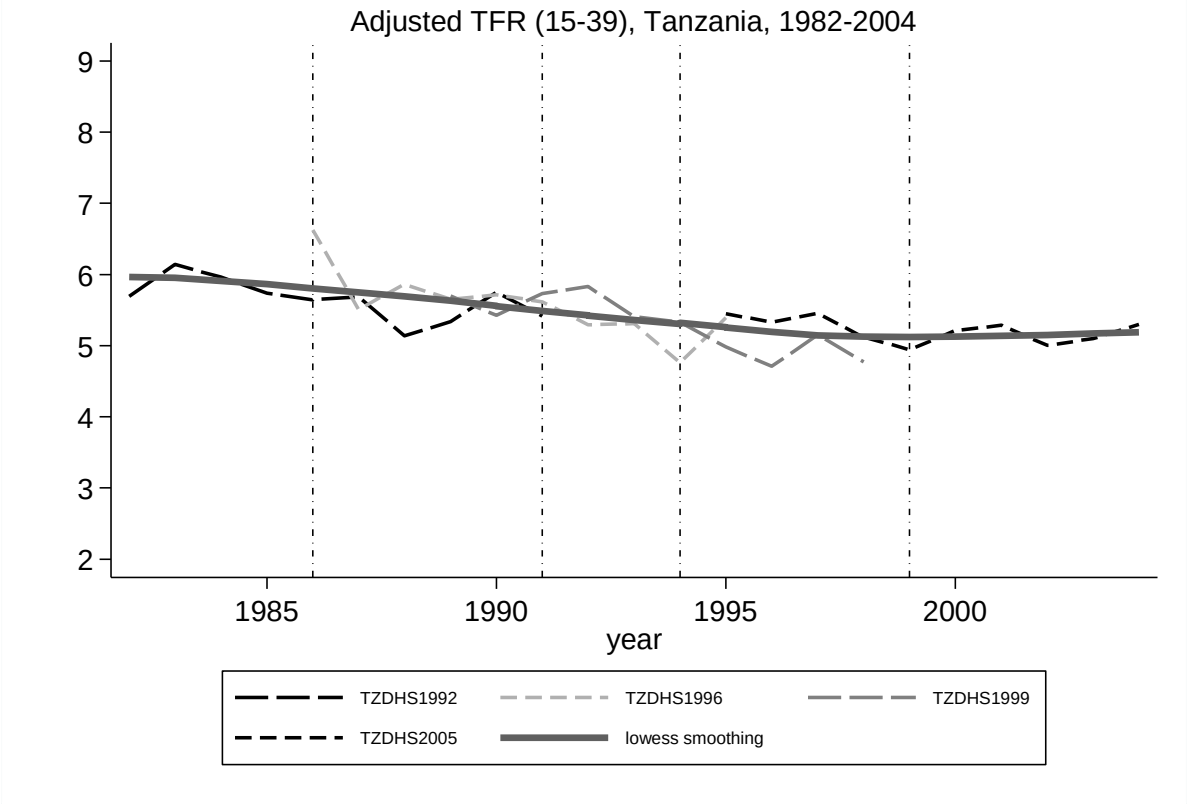

Figure 2.7.3: Tanzania: Partial Total Fertility Rates (15-39) by single calendar year by residence

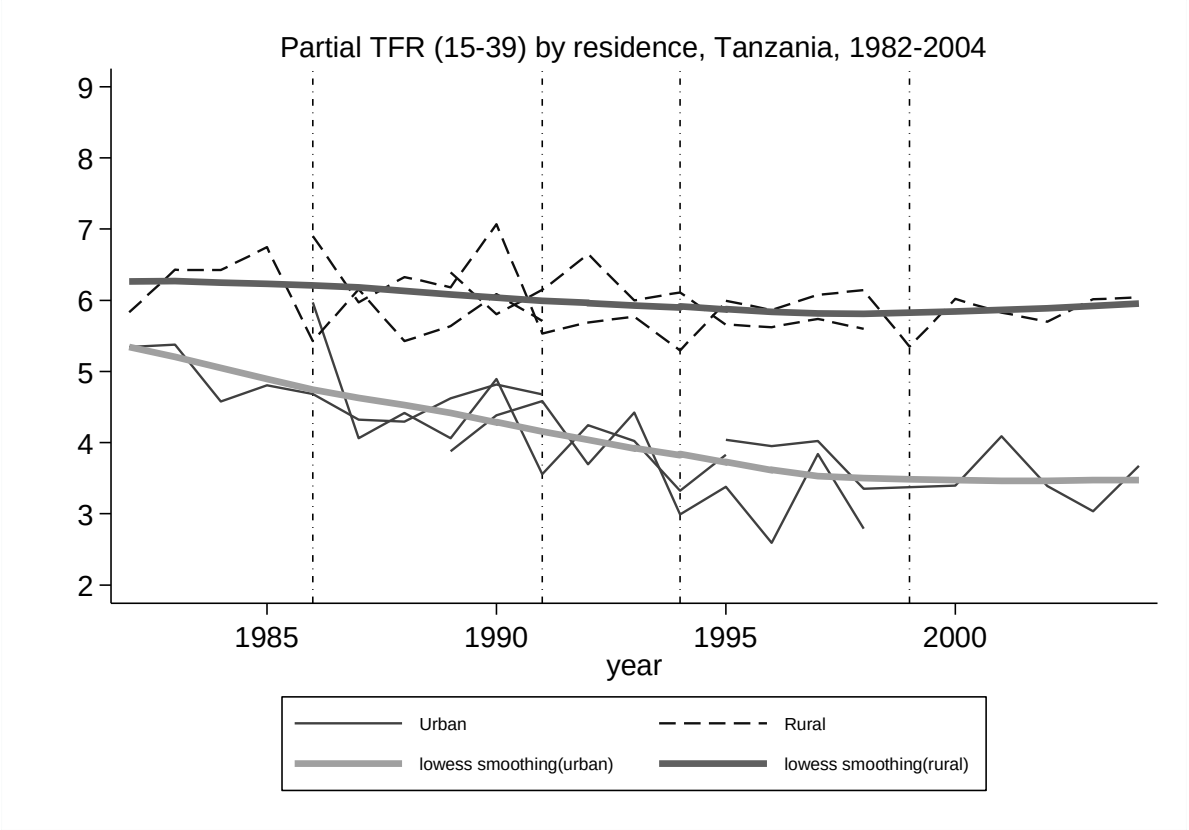

Table 2.7: Tanzania: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI]				Adjusted smoothed TFR (15-39)
	1991/2	1996	1999	20004/5	
1983	6.2 (5.78 - 6.58)				6.0
1984	6.0 (5.56 - 6.44)				5.9
1985	6.3 (5.92 - 6.67)	5.3 (4.88 - 5.69)			5.9
1986	5.3 (4.90 - 5.62)	6.7 (6.31 - 7.10)			5.8
1987	5.7 (5.37 - 6.07)	5.6 (5.25 - 5.92)			5.8
1988	5.2 (4.85 - 5.49)	5.9 (5.53 - 6.33)	5.3 (4.57 - 5.98)		5.7
1989	5.4 (5.05 - 5.69)	5.7 (5.38 - 6.05)	5.7 (4.98 - 6.47)		5.6
1990	5.8 (5.44 - 6.13)	6.6 (6.21 - 6.95)	5.5 (4.81 - 6.10)		5.6
1991	5.5 (5.13 - 5.78)	5.1 (4.72 - 5.44)	5.8 (5.16 - 6.35)		5.5
1992		5.4 (5.01 - 5.70)	5.9 (5.09 - 6.63)		5.4
1993		5.4 (5.01 - 5.73)	5.6 (4.95 - 6.21)		5.4
1994		4.8 (4.52 - 5.12)	5.2 (4.48 - 5.97)	5.6 (5.21 - 5.98)	5.3
1995		5.5 (5.10 - 5.81)	5.0 (4.37 - 5.63)	5.5 (5.09 - 5.89)	5.3
1996			4.7 (4.08 - 5.40)	5.4 (5.00 - 5.76)	5.2
1997			5.2 (4.54 - 5.82)	5.5 (5.16 - 5.86)	5.1
1998			4.8 (4.13 - 5.47)	5.4 (5.02 - 5.76)	5.1
1999				4.8 (4.48 - 5.12)	5.1
2000				5.3 (4.92 - 5.62)	5.1
2001				5.3 (5.01 - 5.65)	5.1
2002				5.0 (4.73 - 5.37)	5.1
2003				5.1 (4.80 - 5.50)	5.2
2004				5.3 (5.02 - 5.67)	5.2

Figure 2.8.1: Uganda: Partial Total Fertility Rates (15-39) by single calendar year

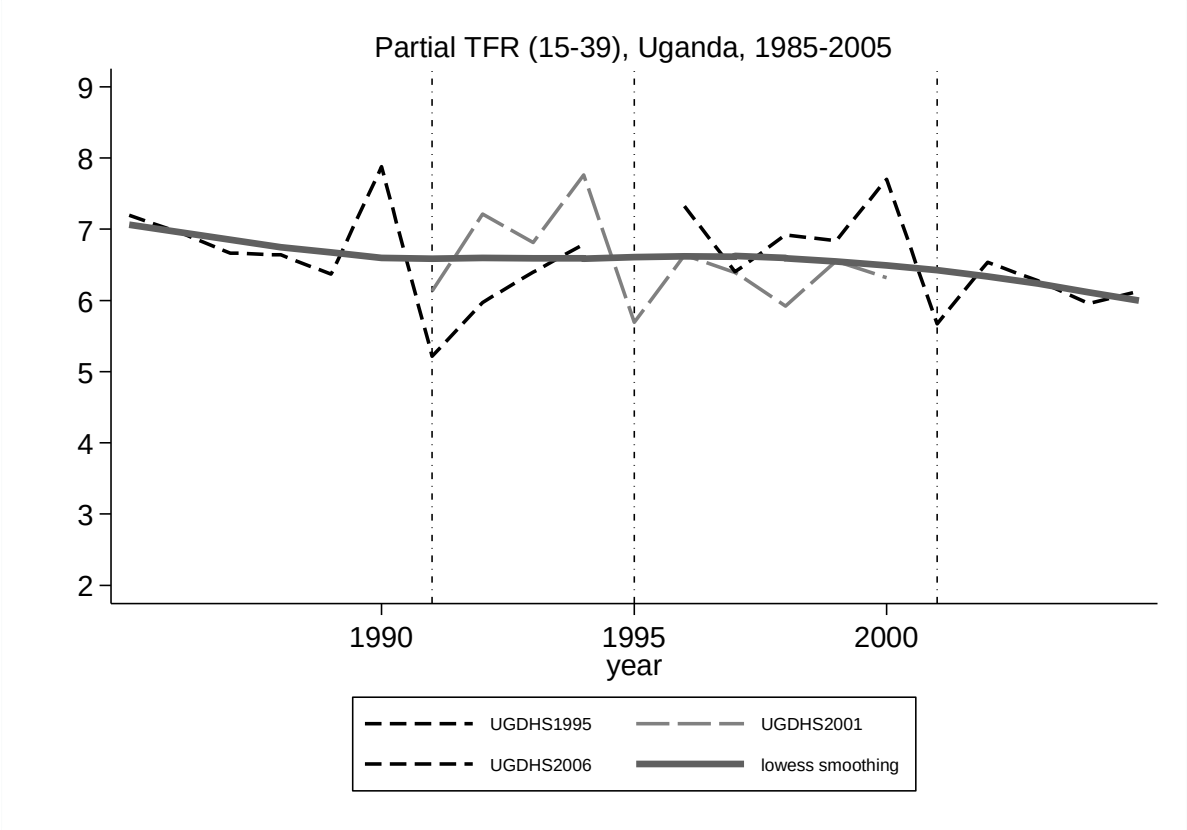

Figure 2.8.2: Uganda: Adjusted partial Total Fertility Rates (15-39) by single calendar year

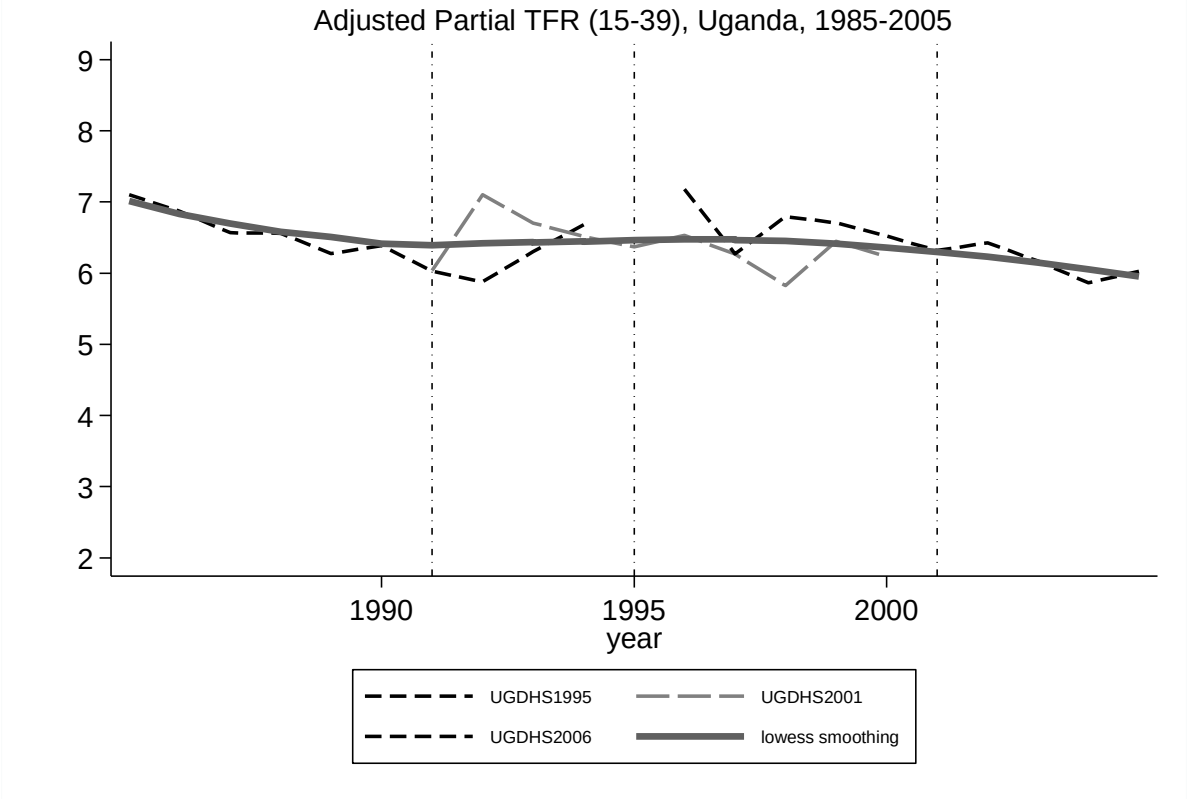

Figure 2.8.3: Uganda: Partial Total Fertility Rates (15-39) by single calendar year by residence

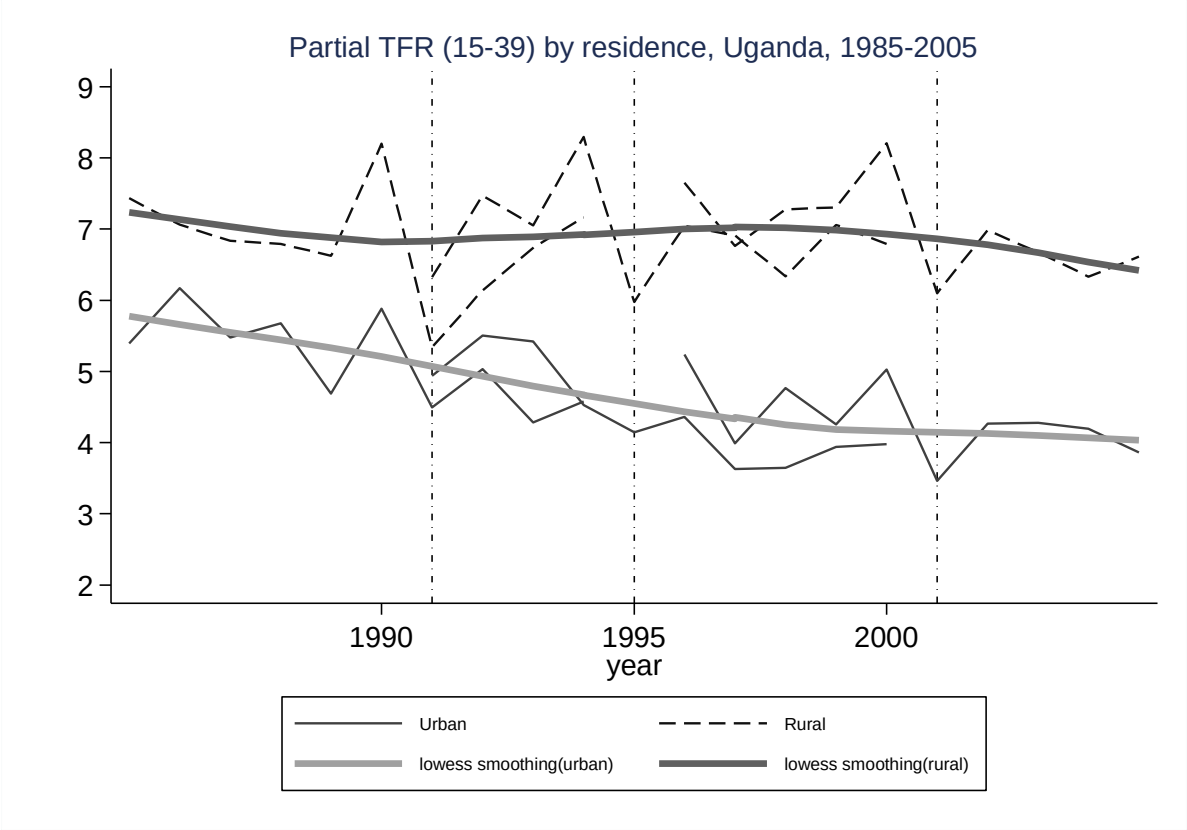

Table 2.8: Uganda: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI] 1995	2000/1	2006	Adjusted smoothed TFR (15-39)
1985	7.2 (6.72 - 7.67)			7.0
1986	7.0 (6.53 - 7.38)			6.8
1987	6.7 (6.25 - 7.08)			6.7
1988	6.6 (6.24 - 7.04)			6.6
1989	6.4 (5.99 - 6.75)			6.5
1990	7.9 (7.40 - 8.35)			6.4
1991	5.2 (4.85 - 5.58)	6.1 (5.70 - 6.56)		6.4
1992	6.0 (5.62 - 6.33)	7.2 (6.80 - 7.63)		6.4
1993	6.4 (6.04 - 6.75)	6.8 (6.39 - 7.24)		6.4
1994	6.8 (6.41 - 7.17)	7.8 (7.33 - 8.19)		6.4
1995		5.7 (5.32 - 6.06)	6.6 (6.20 - 7.01)	6.5
1996		6.6 (6.23 - 7.04)	7.3 (6.94 - 7.70)	6.5
1997		6.4 (6.04 - 6.75)	6.4 (6.00 - 6.80)	6.5
1998		5.9 (5.55 - 6.29)	6.9 (6.56 - 7.28)	6.5
1999		6.6 (6.17 - 6.93)	6.8 (6.46 - 7.21)	6.4
2000		6.3 (5.93 - 6.71)	7.7 (7.32 - 8.08)	6.4
2001			5.7 (5.33 - 6.02)	6.3
2002			6.5 (6.19 - 6.89)	6.2
2003			6.3 (5.91 - 6.63)	6.2
2004			6.0 (5.64 - 6.27)	6.1
2005			6.1 (5.78 - 6.48)	6.0

Figure 2.9.1: Zambia: Partial Total Fertility Rates (15-39) by single calendar year

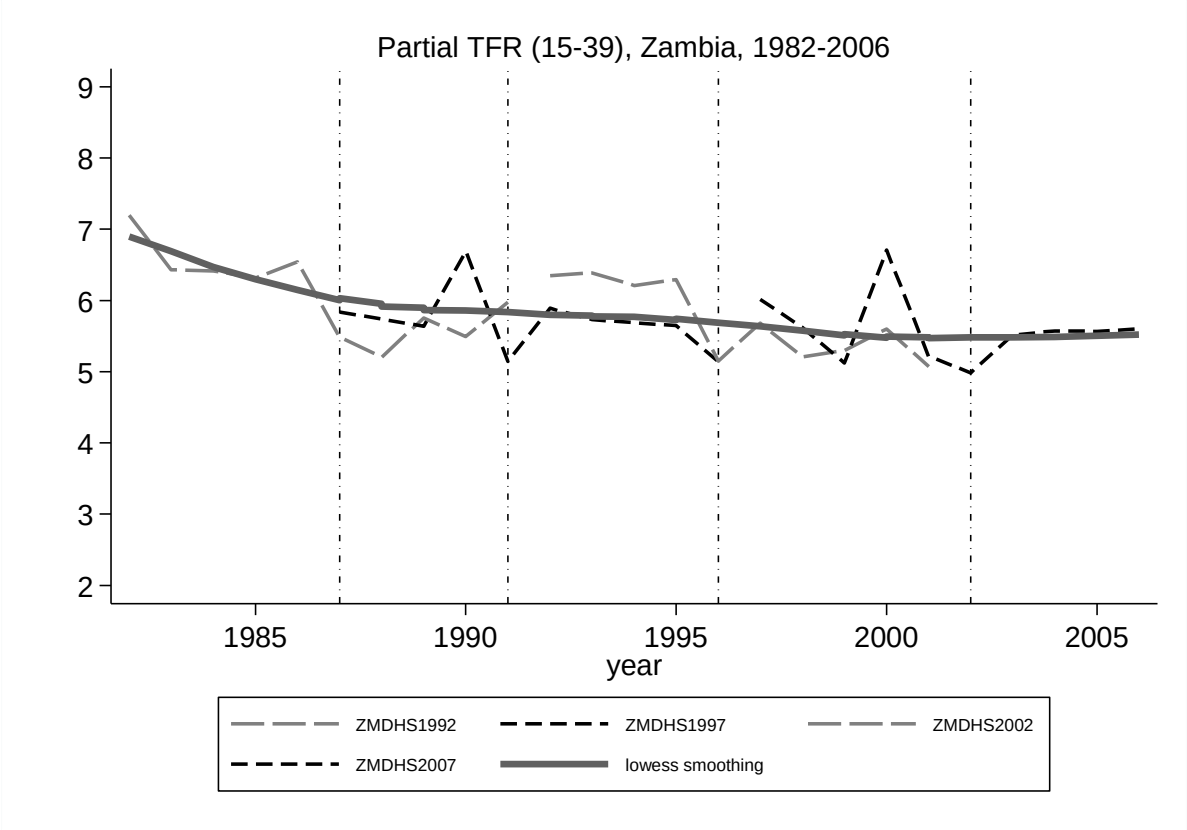

Figure 2.9.2: Zambia: Adjusted partial Total Fertility Rates (15-39) by single calendar year

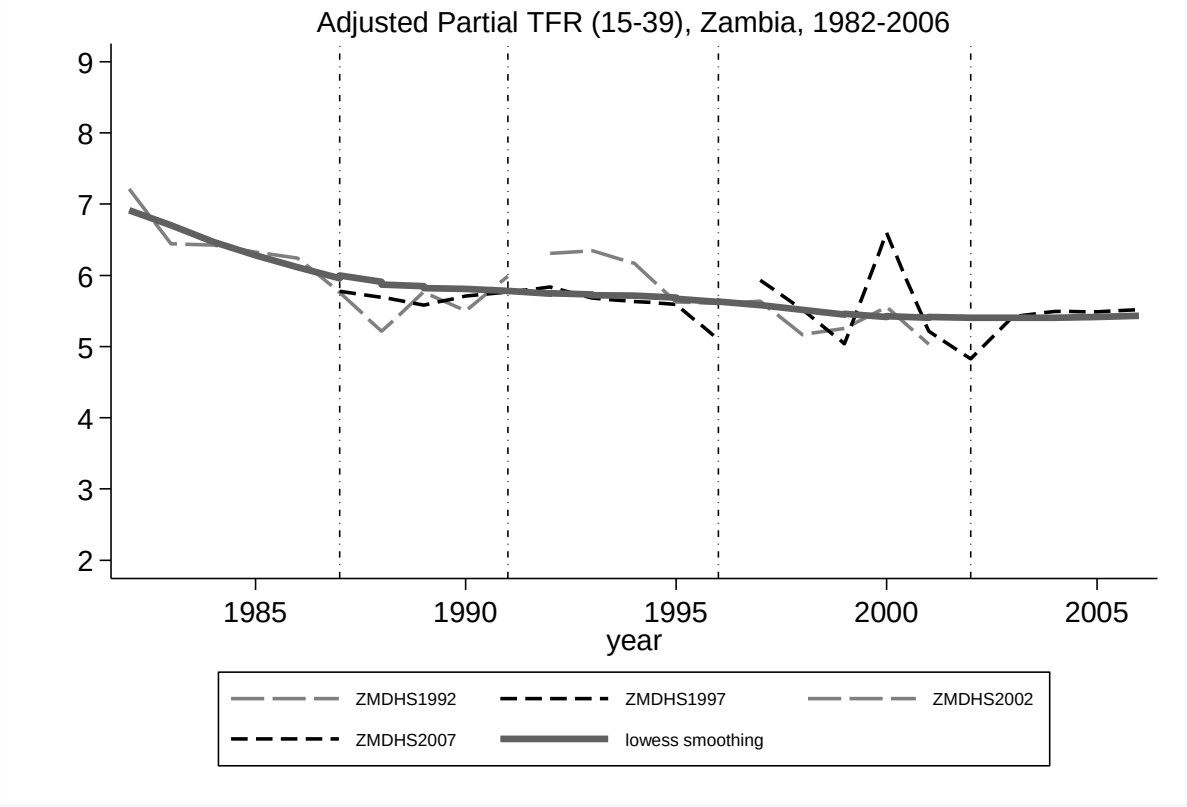

Figure 2.9.3: Zambia: Partial Total Fertility Rates (15-39) by single calendar year by residence

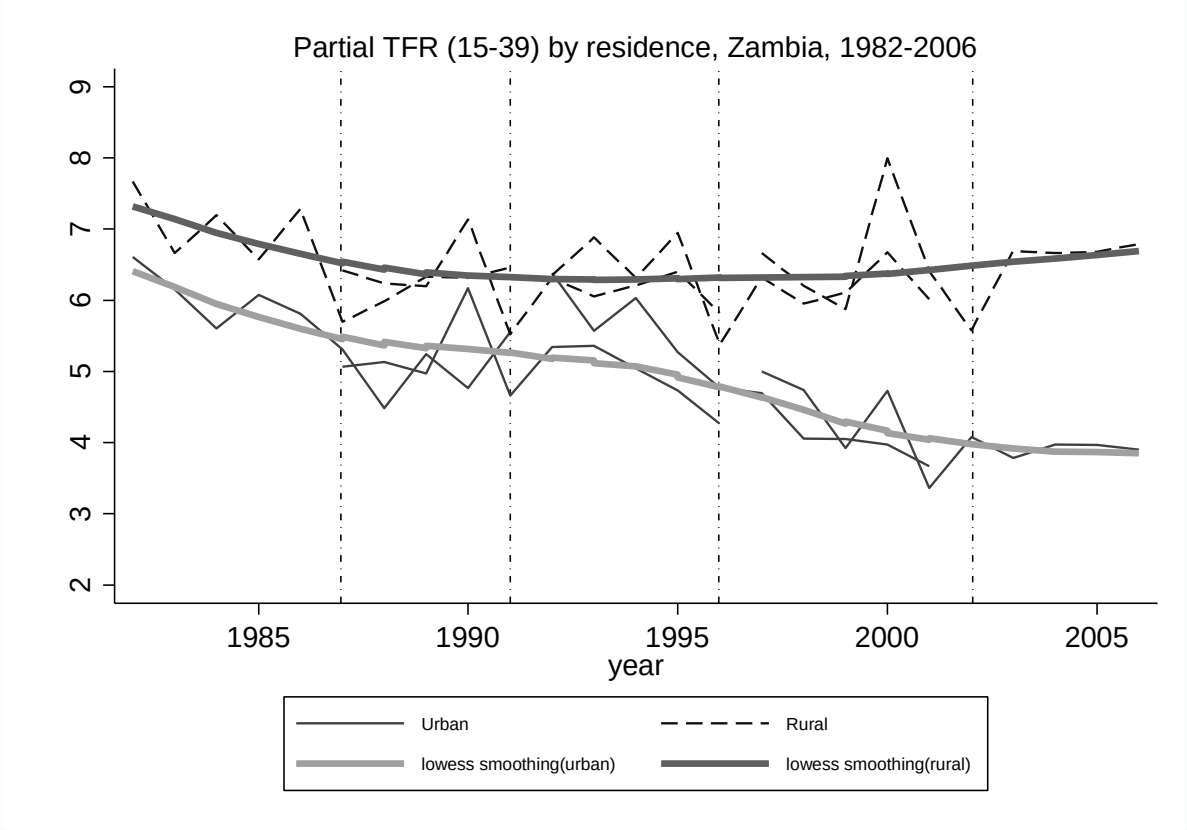

Table 2.9: Zambia: Partial Total Fertility Rates (15-39) by year and survey

Year/ Survey	TFR (15-39) [95% CI]				Adjusted smoothed TFR (15-39)
	1992	1996	2001/2	2007	
1983	6.4 (6.07 - 6.79)				6.7
1984	6.4 (6.03 - 6.80)				6.5
1985	6.3 (5.96 - 6.66)				6.3
1986	6.5 (6.18 - 6.90)	6.6 (6.22 - 7.01)			6.1
1987	5.5 (5.15 - 5.83)	5.8 (5.44 - 6.23)			6.0
1988	5.2 (4.88 - 5.53)	5.7 (5.39 - 6.09)			5.9
1989	5.8 (5.38 - 6.13)	5.6 (5.26 - 6.01)			5.8
1990	5.5 (5.16 - 5.83)	6.7 (6.28 - 7.10)			5.8
1991	6.0 (5.64 - 6.31)	5.1 (4.80 - 5.49)	6.0 (5.62 - 6.43)		5.8
1992		5.9 (5.55 - 6.23)	6.3 (5.93 - 6.77)		5.7
1993		5.7 (5.44 - 6.02)	6.4 (6.01 - 6.76)		5.7
1994		5.7 (5.40 - 5.97)	6.2 (5.84 - 6.58)		5.7
1995		5.6 (5.32 - 5.98)	6.3 (5.90 - 6.68)		5.7
1996			5.2 (4.84 - 5.46)	5.9 (5.46 - 6.31)	5.6
1997			5.7 (5.35 - 6.01)	6.0 (5.60 - 6.43)	5.6
1998			5.2 (4.89 - 5.53)	5.6 (5.22 - 6.02)	5.5
1999			5.3 (4.94 - 5.65)	5.1 (4.75 - 5.50)	5.5
2000			5.6 (5.25 - 5.95)	6.7 (6.28 - 7.13)	5.4
2001			5.1 (4.73 - 5.41)	5.2 (4.80 - 5.63)	5.4
2002				5.0 (4.64 - 5.33)	5.4
2003				5.5 (5.14 - 5.89)	5.4
2004				5.6 (5.18 - 5.97)	5.4
2005				5.6 (5.17 - 5.97)	5.4
2006				5.6 (5.23 - 5.97)	5.4

APPENDIX 3: INTER-SURVEY COMPARISON: COMPOSITION OF RESPONDENTS

Table 3.1: Benin: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]																	
	1996						2001						2006					
1950-59	4.3	(	2.89	-	6.20	)	8.5	(	6.52	-	10.90	)	7.6	(	5.57	-	10.34	)
1960-69	12.0	(	10.20	-	14.16	)	12.9	(	10.90	-	15.14	)	11.3	(	10.04	-	12.74	)
1970-79	10.5	(	8.72	-	12.51	)	11.1	(	9.41	-	12.98	)	9.9	(	8.93	-	10.91	)
1980-89	13.8	(	9.81	-	19.05	)	20.7	(	18.1	-	23.44	)	21.6	(	20.03	-	23.16	)

Table 3.2: Cameroon: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]																	
	1991						1998						2004					
1950-59	15.8	(	12.39	-	19.84	)	15.2	(	12.17	-	18.74	)	18.6	(	15.75	-	21.85	)
1960-69	28.9	(	24.07	-	34.33	)	29.7	(	25.67	-	34.07	)	27.9	(	25.42	-	30.53	)
1970-79	39.7	(	34.09	-	45.64	)	42.5	(	37.88	-	47.15	)	39.9	(	37.36	-	42.39	)
1980-89	na						37.8	(	32.16	-	43.72	)	46.4	(	43.93	-	48.85	)

Table 3.3: Ghana: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]																				
	1993					1998					2003					2008					
1940-49	22.3	(	17.84	-	27.58	)	38.9	(	27.86	-	51.18	)	na					na				
1950-59	42.5	(	39.00	-	46.09	)	41.0	(	37.20	-	44.86	)	42.4	(	37.95	-	47.06	)	53.1	(	38.89	-	66.80	)
1960-69	46.3	(	43.06	-	49.46	)	48.7	(	45.22	-	52.10	)	43.5	(	39.80	-	47.17	)	46.1	(	42.27	-	49.93	)
1970-79	58.3	(	54.82	-	61.74	)	56.1	(	53.00	-	59.08	)	49.7	(	46.45	-	53.03	)	51.5	(	48.14	-	54.92	)
1980-89	na						67.4	(	63.27	-	71.22	)	62.4	(	59.38	-	65.25	)	65.5	(	62.71	-	68.26	)

Table 3.4: Kenya: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]																				
	1989					1993					1998					2003					
1940-49	4.1	(	2.92	-	5.70	)	5.7	(	3.91	-	8.36	)	*					na				
1950-59	15.4	(	13.08	-	17.96	)	16.0	(	13.48	-	18.77	)	19.7	(	16.96	-	22.80	)	21.93	(	18.46	-	25.84	)
1960-69	31.3	(	28.79	-	33.82	)	32.3	(	29.36	-	35.35	)	33.0	(	30.14	-	35.98	)	32.09	(	28.73	-	35.65	)
1970-79	20.5	(	15.83	-	26.05	)	26.2	(	23.97	-	28.63	)	36.2	(	33.56	-	38.91	)	32.01	(	29.27	-	34.89	)
1980-89	na						na						18.2	(	15.13	-	21.71	)	27.16	(	24.91	-	29.53	)

Table 3.5: Nigeria: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]																				
	1990					1999					2003					2008					
1950-59	7.8	(	6.22	-	9.72	)	12.5	(	10.25	-	15.19	)	11.4	(	8.40	-	15.26	)	16.3	(	12.75	-	20.66	)
1960-69	23.4	(	19.41	-	27.89	)	30.6	(	27.14	-	34.19	)	23.7	(	20.03	-	27.71	)	27.0	(	24.87	-	29.33	)
1970-79	30.7	(	26.19	-	35.52	)	43.6	(	40.02	-	47.32	)	38.6	(	33.58	-	43.84	)	39.5	(	36.96	-	42.04	)
1980-89	na						38.1	(	35.19	-	41.19	)	48.8	(	43.99	-	53.67	)	51.3	(	48.69	-	53.89	)

Table 3.6: Rwanda: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]		
	1992	2000	2005
1950-59	4.8 (3.66 - 6.23)	4.5 (3.40 - 5.84)	4.6 (3.16 - 6.51)
1960-69	9.7 (8.04 - 11.72)	10.1 (8.50 - 11.91)	9.1 (7.81 - 10.48)
1970-79	10.0 (8.28 - 11.98)	15.5 (13.59 - 17.64)	12.4 (11.10 - 13.87)
1980-89	na	8.9 (7.64 - 10.44)	9.4 (8.40 - 10.47)

Table 3.7: Tanzania: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]			
	1991/2	1996	1999	2004/5
1950-59	3.2 (2.28 - 4.60)	2.6 (1.77 - 3.82)	3.2 (1.87 - 5.35)	2.9 (1.91 - 4.43)
1960-69	4.9 (3.28 - 7.20)	5.2 (4.19 - 6.49)	4.9 (3.44 - 7.00)	5.2 (3.86 - 6.93)
1970-79	7.2 (5.21 - 9.93)	7.3 (5.84 - 9.17)	7.0 (5.10 - 9.62)	9.0 (7.33 - 10.88)
1980-89	na	*	4.3 (2.96 , 6.21)	10.8 (9.20 , 12.64)

Table 3.8: Uganda: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]		
	1995	2000/1	2006
1950-59	8.7 (6.75 - 11.04)	9.6 (7.46 - 12.24)	9.1 (6.20 - 13.25)
1960-69	14.0 (11.73 - 16.52)	12.6 (10.57 - 15.05)	11.4 (9.43 - 13.64)
1970-79	16.0 (13.86 - 18.45)	20.9 (18.49 - 23.60)	17.5 (15.40 - 19.73)
1980-89	*	23.2 (20.34 - 26.31)	29.9 (27.20 - 32.64)

Table 3.9: Zambia: Proportion of women with secondary or higher education by birth cohort and survey (%)

Survey / Birth Cohort	Proportion of women with secondary or higher education [95% CI]			
	1992	1996	2001/2	2007
1950-59	22.8 (19.89 - 25.96)	23.3 (20.00 - 26.94)	17.7 (14.86 - 21.00)	24.0 (17.31 - 32.33)
1960-69	28.1 (25.61 - 30.64)	28.0 (25.30 - 30.92)	23.7 (21.00 - 26.58)	21.8 (18.34 - 25.58)
1970-79	25.4 (22.93 - 28.10)	32.7 (30.06 - 35.36)	33.2 (30.08 - 36.53)	31.3 (28.53 - 34.29)
1980-89	na	21.0 (17.86 - 24.40)	34.1 (31.27 - 37.07)	41.9 (38.87 - 44.98)

* an asterisk indicates a figure is based on fewer than 25 unweighted cases and has been suppressed.

APPENDIX 4: INTER-SURVEY COMPARISON: AVERAGE PARITY

Table 4.1: Benin: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]			
	1996	2001 reconstructed for 1996	2001	2006 reconstructed for 2001
1950-59	6.6 (6.42 - 6.78)	6.5 (6.29 - 6.72)	6.9 (6.67 - 7.14)	6.6 (6.43 - 6.84)
1960-69	4.2 (4.05 - 4.31)	4.3 (4.12 - 4.39)	5.4 (5.19 - 5.51)	5.4 (5.29 - 5.49)
1970-79	1.1 (1.07 - 1.20)	1.2 (1.15 - 1.31)	2.5 (2.41 - 2.62)	2.7 (2.65 - 2.77)
1980-89	*	*	0.4 (0.35 - 0.44)	0.4 (0.35 - 0.40)

Table 4.2: Cameroon: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]			
	1991	1998 reconstructed for 1991	1998	2004 reconstructed for 1998
1950-59	5.3 (5.14 - 5.55)	5.3 (5.05 - 5.49)	6.1 (5.82 - 6.32)	6.2 (5.93 - 6.38)
1960-69	3.0 (2.88 - 3.16)	2.8 (2.70 - 2.95)	4.4 (4.22 - 4.59)	4.6 (4.50 - 4.75)
1970-79	0.6 (0.51 - 0.66)	0.0 (0.33 - 0.42)	1.6 (1.49 - 1.69)	1.7 (1.66 - 1.80)
1980-89	na	na	0.2 (0.16 - 0.24)	0.1 (0.08 - 0.11)

Table 4.3: Ghana: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]			
	1998	2003 reconstructed for 1998	2003	2008 reconstructed for 2003
1950-59	5.6 (5.45 - 5.83)	5.5 (5.23 - 5.70)	5.8 (5.51 - 6.01)	5.9 (5.21 - 6.60)
1960-69	3.7 (3.62 - 3.86)	3.9 (3.72 - 3.99)	4.6 (4.43 - 4.74)	4.6 (4.46 - 4.81)
1970-79	1.3 (1.26 - 1.40)	1.3 (1.26 - 1.41)	2.3 (2.20 - 2.39)	2.4 (2.26 - 2.47)
1980-89	0.1 (0.07 - 0.11)	0.0 (0.03 - 0.05)	0.4 (0.32 - 0.38)	0.4 (0.34 - 0.42)

Table 4.4: Kenya: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]			
	1993	1998 reconstructed for 1993	1998	2003 reconstructed for 1998
1940-49	7.7 (7.37 - 7.96)	6.9 (6.43 - 7.40)	7.0 (6.53 - 7.49)	na
1950-59	6.1 (5.96 - 6.30)	5.9 (5.78 - 6.12)	6.3 (6.14 - 6.50)	6.2 (5.91 - 6.39)
1960-69	3.3 (3.17 - 3.38)	3.3 (3.14 - 3.36)	4.2 (4.09 - 4.35)	4.3 (4.12 - 4.43)
1970-79	0.5 (0.49 - 0.57)	0.5 (0.48 - 0.56)	1.4 (1.37 - 1.51)	1.5 (1.43 - 1.59)
1980-89	na	na	0.1 (0.07 - 0.12)	0.0 (0.04 - 0.06)

Table 4.5: Nigeria: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]			
	1990	1999 reconstructed for 1990	1999	2003 reconstructed for 1999
1940-49	6.8 (6.48 - 7.08)	6.3 (5.63 - 7.05)	6.8 (5.99 - 7.70)	na
1950-59	5.3 (5.06 - 5.45)	4.9 (4.73 - 5.11)	6.1 (5.87 - 6.31)	6.9 (6.50 - 7.21)
1960-69	2.7 (2.62 - 2.86)	2.3 (2.17 - 2.37)	4.4 (4.29 - 4.58)	5.3 (5.10 - 5.52)
1970-79	0.5 (0.44 - 0.58)	0.2 (0.22 - 0.27)	1.7 (1.61 - 1.79)	2.0 (1.87 - 2.19)
1980-89	na	na	0.1 (0.09 - 0.14)	0.1 (0.11 - 0.16)

Table 4.6: Rwanda: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]			
	1992	2000 reconstructed for 1992	2000	2005 reconstructed for 2000
1950-59	5.9 (5.72 - 6.03)	5.7 (5.56 - 5.81)	6.9 (6.78 - 7.06)	6.8 (6.57 - 6.98)
1960-69	2.5 (2.40 - 2.62)	2.6 (2.53 - 2.71)	4.8 (4.66 - 4.89)	4.9 (4.77 - 4.99)
1970-79	0.3 (0.22 - 0.28)	0.2 (0.19 - 0.24)	1.8 (1.72 - 1.86)	1.9 (1.79 - 1.92)
1980-89	na	na	0.1 (0.09 - 0.13)	0.1 (0.07 - 0.10)

Table 4.7: Tanzania: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]		
	1996	1999 reconstructed for 1996	1999	2004/5 reconstructed for 1999
1940-49	7.4 (7.07 - 7.74)	8.3 (6.46 - 10.23)	*	na
1950-59	6.5 (6.31 - 6.67)	6.4 (6.08 - 6.75)	6.6 (1.87 - 5.35)	6.6 (6.32 - 6.84)
1960-69	4.0 (3.84 - 4.07)	3.9 (3.70 - 4.13)	4.5 (4.25 - 4.78)	4.7 (4.58 - 4.87)
1970-79	1.2 (1.13 - 1.26)	1.2 (1.11 - 1.30)	2.0 (1.83 - 2.09)	2.0 (1.90 - 2.05)
1980-89	0.1 (0.03 - 0.08)	0.0 (0.01 - 0.03)	0.2 (0.17 - 0.25)	0.1 (0.11 - 0.14)

Table 4.8: Uganda: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]		
	1995	2000/01 reconstructed for 1995	2000/01	2006 reconstructed for 2000/01
1950-59	6.7 (6.48 - 6.88)	6.7 (6.44 - 6.94)	7.2 (6.94 - 7.49)	7.5 (7.12 - 7.84)
1960-69	4.3 (4.13 - 4.38)	4.5 (4.32 - 4.59)	5.8 (5.62 - 5.93)	6.0 (5.83 - 6.16)
1970-79	1.2 (1.18 - 1.31)	1.3 (1.22 - 1.35)	3.0 (2.92 - 3.11)	3.2 (3.11 - 3.28)
1980-89	*	*	0.5 (0.46 - 0.56)	0.4 (0.32 - 0.48)

Table 4.9: Zambia: Average parity by birth cohort and survey

Survey / Birth Cohort	Average parity [95% CI]		
	1996	2001/02 reconstructed for 1996	2001/02	2007 reconstructed for 2001/02
1950-59	6.6 (6.47 - 6.82)	6.9 (6.63 - 7.09)	7.3 (7.02 - 7.50)	6.7 (6.15 - 7.20)
1960-69	4.2 (4.06 - 4.30)	4.4 (4.28 - 4.53)	5.5 (5.34 - 5.64)	5.5 (5.33 - 5.66)
1970-79	1.3 (1.26 - 1.36)	1.4 (1.30 - 1.42)	2.7 (2.63 - 2.81)	2.8 (2.67 - 2.86)
1980-89	0.1 (0.04 - 0.07)	0.0 (0.03 - 0.04)	0.6 (0.54 - 0.62)	0.4 (0.41 - 0.48)

* an asterisk indicates a figure is based on fewer than 25 unweighted cases and has been suppressed.

APPENDIX 5: AVERAGE PACE OF FERTILITY DECLINE

Table 5.1: Average pace of fertility decline

Country	Year			Adjusted smoothed TFR (15-39)		Average pace per year (in child)	Relative pace to previous period	Trend
Benin	1996	-	2001	5.7	5.3	0.080		
	2001	-	2005	5.3	5.2	0.025	0.3	Stall
Cameroon	1991	-	1998	5.5	4.9	0.086		
	1998	-	2003	4.9	4.7	0.040	0.5	Decline
Ghana	1993	-	1998	4.6	4.2	0.080		
	1998	-	2003	4.2	3.9	0.060	0.8	Decline
	2003	-	2007	3.9	3.6	0.075	1.3	Decline
Kenya	1993	-	1998	4.8	4.5	0.060		
	1998	-	2002	4.5	4.5	0.000	0.0	Stall
Nigeria	1990	-	1999	5.7	5.4	0.033		
	1999	-	2003	5.4	5.3	0.025	0.8	Decline
	2003	-	2007	5.3	5.1	0.050	2.0	Decline
Rwanda	1992	-	2000	5.8	5.3	0.063		
	2000	-	2004	5.3	5.2	0.025	0.4	Stall
Tanzania	1996	-	1999	5.2	5.1	0.033		
	1999	-	2004	5.1	5.2	-0.020	-0.6	Early-transition
Uganda	1990	-	1995	6.4	6.5	-0.020		
	1995	-	2000	6.5	6.4	0.020	-1.0	Early-transition
	2000	-	2005	6.4	6.0	0.080	4.0	Early-transition
Zambia	1991	-	1996	5.7	5.6	0.020		
	1996	-	2001	5.6	5.4	0.040	2.0	Decline
	2001	-	2006	5.4	5.4	0.000	0.0	Stall