Fertility decline in urban and rural areas in 17 sub-Saharan African countries

Kazuyo Machiyama, Richard Silverwood, Andy Sloggett, John Cleland
London School of Hygiene and Tropical Medicine

Background

Urbanization is one of the most significant demographic transformations in sub-Saharan Africa. Population in urban areas was only 26 percent in 1975, it is currently 40 percent, and is projected to increase to 62 percent by 2050 (United Nations 2009). The Western and Middle Africa region has one of fastest growing regions urban populations. In 2007 the overall urbanization rate had already reached 41.7 percent and by 2025 a half of the people are expected to live in urban areas (UN-HABITAT 2010). In particular, the Ibadan-Lagos-Cotonou-Lomé-Accra corridor, known as the GILA corridor, in the Gulf of Guinea would be connected as a single large coastal urban area, spanning Nigeria, Benin, Togo, and Ghana. East Africa is one of the least urbanized regions in the world but urbanization is accelerating. The urban population has increased from 13.4 percent to 20.5 % between 1980 and 2007 (UN-HABITAT 2010). Table 1 shows high urbanization in Cameroon, Ghana, Senegal and Zambia while over 70 percent of people live in rural areas in Kenya.

Residence is an important driver associated with fertility decline. Women living in urban areas are more likely to postpone marriage, and have access to education, health services and formal jobs as well as to adopt new technologies such as use of modern contraception.

Fertility is lower in urban than in rural areas. The DHS surveys conducted in developing countries in 1995-1999 revealed fertility differentials in all surveys (Rutstein 2003). Urban areas often initiate fertility transition and then rural areas follow. Garenne claimed that fertility in urban areas of sub-Saharan Africa initiated decline in approximately the early 1960s and rural areas followed in the 1980s or 1990s (Garenne 2008). The TFRs in Lome, Yaounde-Douala, Accra, Abidjan, and Addis Ababa declined to below 3 children whereas the levels in the rural areas still exceeded 6 children per woman (Macro International Inc. 2011). Urban areas often contain a concentration of women with a higher level of education and income, as well as higher

1

contraceptive prevalence and later marriage. The Ethiopian case is an extreme example. In Addis Ababa fertility fell substantially from 3.1 to 1.9 children per woman between 1990 and 2000, while in rural areas it remained 6.4 in 2005. This difference is attributable mainly to postponement of marriage due to high living costs, and increased contraceptive use (Sibanda, Woubalem et al. 2003). It is suggested that urbanization is more closely associated with postponement of marriage than education (Cleland, Casterline et al. 1984). Also there is some evidence that spousal separation caused by urbanization reduces the frequency of sexual intercourse (Brockerhoff and Yang 1994).

Given the rapid urbanization and slower fertility decline in sub-Saharan Africa, it is important to examine how fertility has changed in urban and rural areas, and whether gaps have narrowed over time.

Table 1: Percentage of women by type of residence in selected 5 countries

Cameroon				Ghana					Senegal			
	1991	1998	2004	1988	1993	1998	2003	2008	1986	1992/3	1997	2005
Urban	42.0	35.3	54.8	33.9	37.7	35.9	48.4	48.5	41.0	41.8	44.2	48.7
Rural	58.0	64.7	45.2	66.1	62.3	64.1	51.6	51.5	59.0	58.2	55.8	51.3

	Kenya					Zambia			
	1989	1993	1998	2003	2008/9	1992	1996	2001/2	2007
Urban	17.3	17.8	23.2	25.1	25.4	51.5	44.9	40.1	42.1
Rural	82.7	82.2	76.8	74.9	74.6	48.5	55.1	59.9	57.9

Source: DHS STATcompiler

Methods

Data

To examine the fertility trends over long periods, this study selected 64 DHS surveys in 17 sub-Saharan African countries with three or more DHS surveys available by August 2011. These are Benin, Burkina Faso, Cameroon, Ghana, Kenya, Madagascar, Malawi, Mali, Namibia, Niger, Nigeria, Rwanda, Senegal Tanzania, Uganda, Zambia and Zimbabwe.

Analysis methods

Partial TFR estimates for ages 15-39 were generated for each of the 10 calendar years prior to the year of fieldwork of each survey. Partial TFRs are preferred to full TFRs to circumvent the problem of truncation of ages 40-49. Fertility rates of women 40-49 usually contribute only 10 per cent of a full TFR (Garenne 2008). Extending the analysis beyond this 10-year period would bring increasing problems of truncation and data quality.

The TFR (15-39) estimates were adjusted for downward age displacement of women and backward age displacement of children using Pullum's method (Pullum 2006; Machiyama 2010). The estimated proportions of women aged 15-19 misreported as aged 10-14 were transferred back to the 15-19 age group to adjust for downward age shifting of women. It was necessary to assume that such women were nulliparous. Age displacement of children was corrected by estimating proportions of children transferred across the boundary year. This correction assumed that age transfer was restricted to the two years across the boundary year (Pullum 2006). Subsequently, partial TFRs were re-estimated using the above adjusted number of births and women-years.

We applied the method developed by Murray et al. (Murray, Laakso et al. 2007) for child mortality estimation to fit Loess (locally weighted scatterplot smoothing) regression curves to adjusted partial TFR data points. Loess is a widely used smoothing method, which produces a new smoothed value for each required time point by running a linear regression with the highest weight on data points close to the time point of interest and smaller weights for other data points according to their distance from the time point of interest. This procedure was repeated to obtain smoothed values for every year. The basic Loess function used is:

$$\log(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$$

where y is the partial TFR (15-39), x_1 is calendar year, x_2 is type of residence (urban $= 0$, rural $=1$) and ε is an error term.

This function was fitted using weighted least squares regression. The weights for each data point were tuned by a parameter α which controls the proportion of data points with non-zero weights and hence the degree of smoothing. For instance, when α is 0.5, the 50 per cent of adjusted partial TFR data points closest to the time of interest x_0 are used to fit the weighted least squares regression line. Thus, the smaller the α value, the fewer data points the model uses,

making it more sensitive to short-term changes. The detailed definition of α and the weighting function is given in Murray et al. (2007). When predicting the partial TFR (15-39) for time points later than the most recent observed TFR we used the weights corresponding to the last observed data point.

To estimate uncertainty intervals for each country we used a range of α values between 0.1 and 1.0, starting with the lowest value of α that could be used given the number of observed data points, and increasing the value of α by 0.05 until 1.0. For each value of α the Loess function was fitted using weighted least squares. In order to estimate how uncertain the smoothed trends were, 1000 random draws were simulated from the multivariate normal distribution defined by the estimated/predicted regression coefficients and their variance covariance matrix for each value of α, and the fitted TFR for the required time point was calculated for each set of random draws. The 1000 fitted TFRs per α value were then pooled across the set of α values, with the median value providing the final fitted TFR and the 2.5th and 97.5th centiles giving an uncertainty interval.
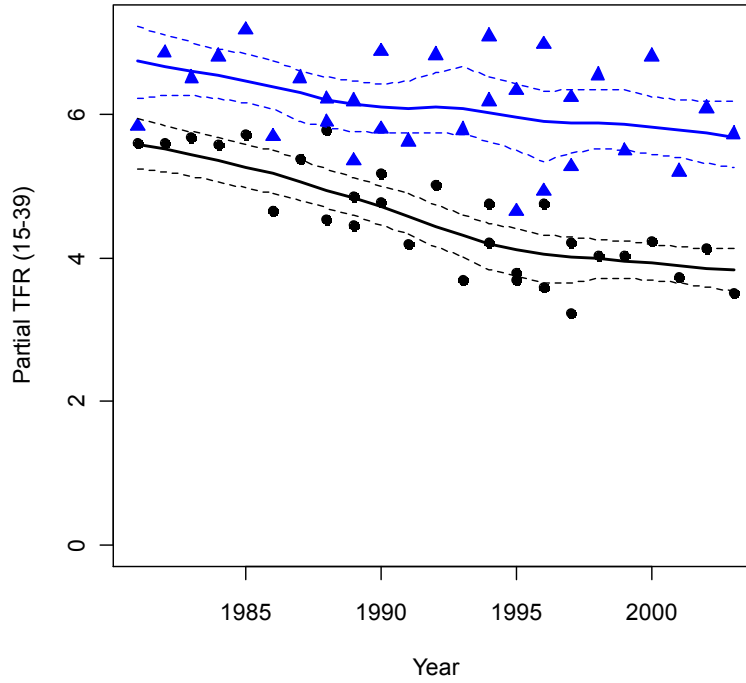
Preliminary Results

Appendix 1 shows variations in the paths of fertility declines across the selected 5 countries. All urban areas showed substantial decline over this period. Urban areas exhibit faster declines in all countries. For instance, in urban Senegal fertility has declined remarkably by over 2 children in the past 20 years. The differences between urban and rural have widened in Cameroon and Zambia because of little or slower changes in rural areas. Kenya has seen almost the same rate of decline in urban and rural areas, so that the gap was maintained over the last 10 years. In Ghana the gap widened and then narrowed.

The results so far suggest that while fertility decline seems to have occurred nationwide in Senegal, Ghana and Kenya, it is more confined to urban areas in Cameroon and Zambia. The wider gap may reflect the limited access to education, health services and family planning in rural areas.
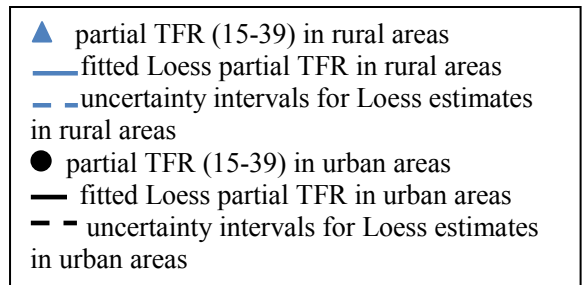
References
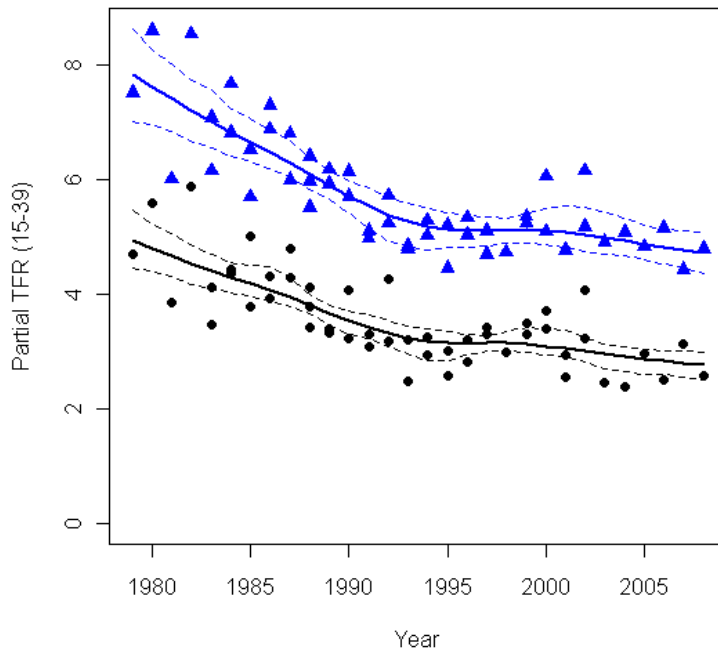
Brockerhoff, M. and X. Yang (1994). "Impact of Migration on Fertility in Sub-Saharan Africa." Social Biology **41**(1-2): 19-43.

Cleland, J., J. Casterline, et al. (1984). "The Effects of Nuptiality, Contraception and Breastfeeding on Fertility in Developing Countries." International Family Planning Perspectives **10**(3): 86-93.

Garenne, M. (2008). Fertility changes in sub-Saharan Africa. DHS Comparative Reports. Calverton, Maryland, Macro International Inc. **No. 18**.

Machiyama, K. (2010). A Re-examination of Recent Fertility Declines in Sub-Saharan Africa DHS Working Papers. Calverton, Maryland, USA, ICF Macro. **68**.

Macro International Inc. (2011). "MEASURE DHS STATcompiler."   Retrieved September 23 2011., from http://www.measuredhs.com.

Murray, C. J., T. Laakso, et al. (2007). "Can we achieve Millennium Development Goal 4?: new analysis of country trends and forecasts of under-5 mortality to 2015." Lancet **370**(9592): 1040-1054.

Pullum, T. W. (2006). An assessment of age and date reporting in the DHS Surveys, 1985-2003. Methodological Reports. Calverton, Maryland, Macro International Inc. **5**.

Rutstein, S. (2003). Fertility Levels, Trends and Differentials: 1995-1999. DHS Comparative Studies. Calverton, Macro International, Inc. **No.3**.

Sibanda, A., Z. Woubalem, et al. (2003). "The Proximate Determinants of the Decline to Below-replacement Fertility in Addis Ababa, Ethiopia." Studies in Family Planning **34**(1): 1-7.

UN-HABITAT (2010). The State of African Cities 2010: Governance, Inequalities and Urban Land Markets. New York, UN-HABITAT.

United Nations (2009). World Urganization Prospectes: The 2009 Revision.

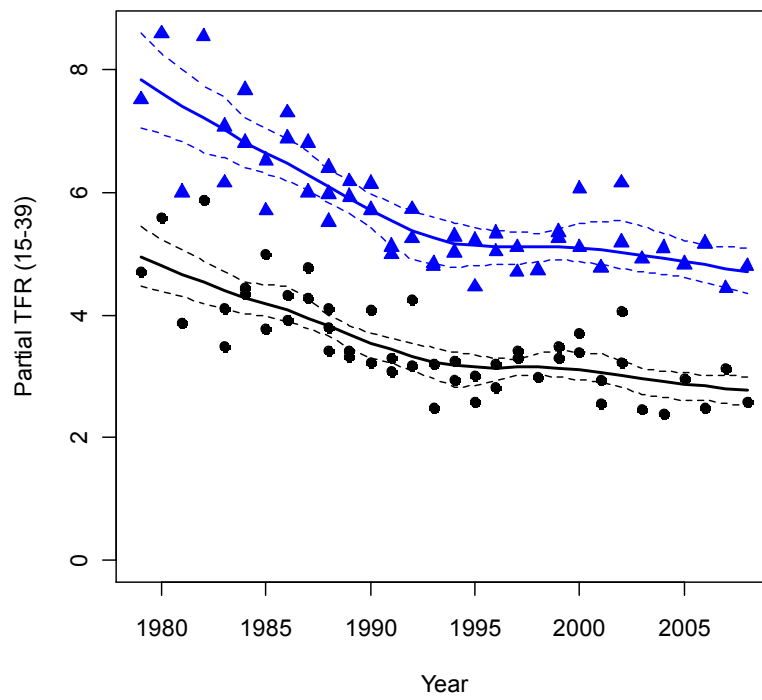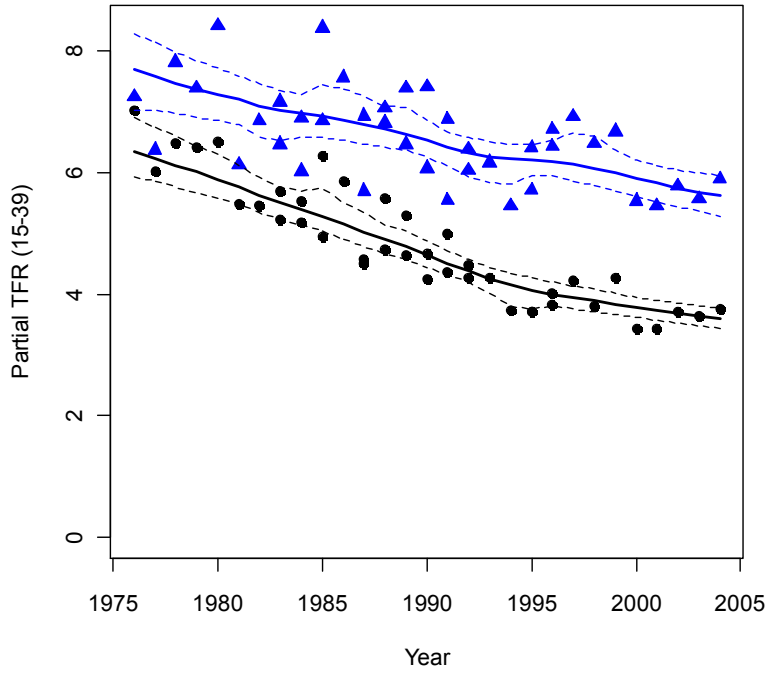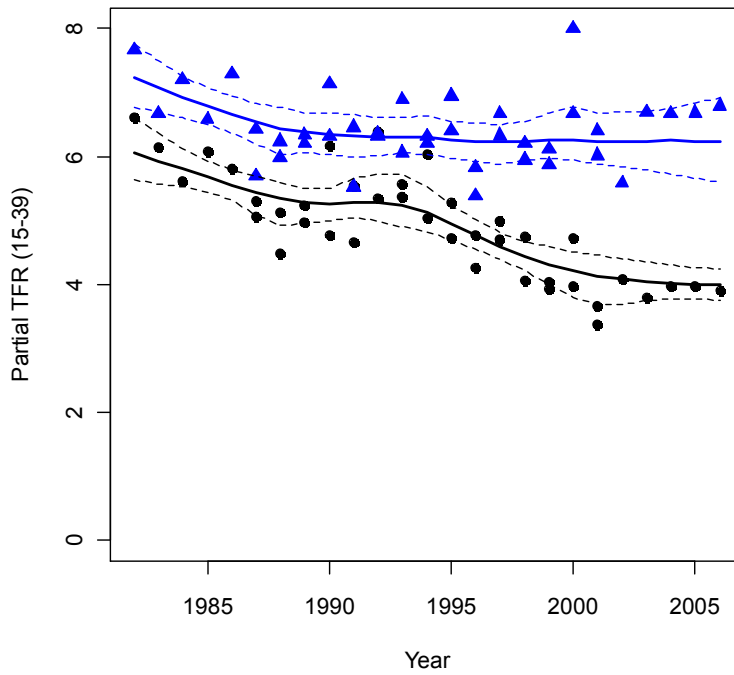**Appendix 1: Partial totally fertility rates by single year, by type of residence**

Cameroon

▲ partial TFR (15-39) in rural areas
—— fitted Loess partial TFR in rural areas
– – uncertainty intervals for Loess estimates
in rural areas
● partial TFR (15-39) in urban areas
—— fitted Loess partial TFR in urban areas
▬ ▬ uncertainty intervals for Loess estimates
in urban areas

Ghana

Kenya

Senegal

Zambia