Ndagurwa and Odimegwu *Genus* (2019) 75:17
https://doi.org/10.1186/s41118-019-0064-z

Genus

ORIGINAL ARTICLE Open Access

The elasticity of marital fertility in three sub-Saharan African countries: a decomposition analysis

Pedzisai Ndagurwa[1,2*] and Clifford Odimegwu[1]

* Correspondence: pndagu@gmail.com
[1]Demography and Population Studies, Schools of Social Sciences and Public Health, Faculty of Humanities, University of the Witwatersrand, Johannesburg, South Africa
[2]MRC/Wits Agincourt Unit, School of Public Health, University of the Witwatersrand, Acornhoek Bushbuckridge, South Africa

Abstract

Many studies of fertility have reported a wide range of factors to be important determinants. These determinants include proximate factors and male and female background variables. However, most of the research has been based on an analysis of cross-sectional fertility elasticities. Therefore, there are limited attempts to examine the temporal behaviour of especially marital fertility in association to the proximate and background determinants. To fill this gap, this study analysed Demographic and Health Survey data for Kenya, Rwanda and Zimbabwe using the Oaxaca-Blinder decomposition technique to determine the magnitude of marital fertility changes in association with selected socioeconomic factors. The results showed evidence of significant marital fertility transitions characterised by stalling for all three countries. Marital fertility rates were more responsive changes in reproductive behaviours than compositional characteristics. Male variables like community level of education were positively associated with stalling especially in Kenya and Zimbabwe. Despite the small contributions overall, analysing male and female variables improves the understanding of the sources of marital fertility changes in patriarchal societies.

Keywords: Marital fertility, Decomposition, Fertility transition, Sub-Saharan Africa, Ghana, Kenya, Rwanda, Zimbabwe

Background and problem statement

Most of sub-Saharan Africa (SSA) continue to have high fertility rates despite evidence of significant fertility transition in some countries starting in the 1970s and 1980s (Askew, Maggwa, & Obare, 2017; Blacker, 2002; Burger, Burger, & Rossouw, 2012; Houle, Pantazis, Kabudula, Tollman, & Clark, 2016; Indongo & Pazvakawambwa, 2012; Letamo & Letamo, 2001; Mbacké, 2017; Mturi & Joshua, 2011; Palamuleni, 2017). In the countries that have experienced long-term decreases in birth rates, their fertility transitions have been characterised by stalling (Bongaarts, 2006; Garenne, 2011; Garenne & Joseph, 2002; Shapiro, 2013; Shapiro & Gebreselassie, 2009). Since the onset of fertility transition in SSA, various scholars have found significant effects of determinants (Bongaarts, 2017, 2015; Bongaarts, Frank, & Lesthaeghe, 1984; Bongaarts & Potter, 1983). Others like Kravdal (2012, 2002), Ezeh and Dodoo (2001), Caldwell and Caldwell (1987) and Caldwell (1977) have investigated the role of the so-called background variables such as education, religious beliefs and gender inequalities in

reproductive decision-making. One of the compelling arguments in fertility literature has been is that family planning services which led to widespread adoption of modern contraceptives have been a crucial influence on fertility transition in SSA (Beguy, Ezeh, Mberu, & Emina, 2017; Casterline & El-Zeini, 2017; Hartmann, Gilles, Shattuck, Kerner, & Guest, 2012; Mbacké, 1994; Mbizvo & Adamchak, 1991; Parr, 2002).

An important feature of the fertility transitions of SSA countries has been the rural-urban divide whereby urban populations started to experience fertility decline about 10 years earlier than their rural counterparts (Garenne & Joseph, 2002; Shapiro & Tambashe, 2002; Shapiro & Tenikue, 2015). Urban centres have provided sociocultural and economic environments that promote fertility limitation earlier than rural areas. Family planning services, formal education, employment opportunities and mass media were first available in urban centres before spreading to rural areas, thus leading to rural-urban divide in the onset of fertility transition (Shapiro & Tambashe, 2002). Factors which distinguish urban from rural contexts such as declines of infant and child mortality rates, increased use of modern contraceptives, delayed age at first marriage, education and female labour-force participation have been important in influencing the decline of fertility in SSA (Blanc & Rutstein, 1994; Bongaarts, 2015; Bongaarts et al., 1984; Bongaarts & Casterline, 2013; Garenne, 2004; Handwerker, 1991; Hertrich, 2017; Mensch, Grant, & Blank, 2006; Ortega, 2014; Shapiro & Gebreselassie, 2014). The findings of the past studies have varied across countries and over time (Bulatao & Casterline, 2001). Some literatures reported that the demand for and use of contraception in SSA were not entirely to limit fertility but as a replacement for traditional methods of birth spacing (Caldwell & Caldwell, 2002; Udjo, 1996). In Zimbabwe for instance, Udjo (1996) reported that the fertility transition was not associated with prevalence rates of modern contraceptives. Some studies have analysed men's influence on the reproductive behaviours of women from SSA countries (Dodoo, 1998, 1993; Dodoo, Luo, & Panayotova, 1997; Dodoo & van Landewijk, 1996). In reviewing the existing literature, one obtains that the decreases of fertility rates in SSA countries have been associated with many of the socioeconomic factors reported in previous studies. However, one can note that many of these studies were based strictly on the cross-sectional design approach employing standard regressions. Furthermore, the fertility literature is dominated by studies which focused on total fertility rates (TFRs) of all women and adolescents. There are few studies which have focused on marital fertility rates which account for most of the fertility in SSA (Ndagurwa & Odimegwu, 2019). This study was therefore designed to investigate the temporal marital fertility elasticities in relation to the various proximate and background variables in Kenya, Rwanda and Zimbabwe. The study sought to address the following research question:

- If the fertility rate of a group of women at a given point in time is explained by their use of modern contraceptives, education status, employment and urban residence among other factors, to what extent do their fertility rate decrease or increase in response to changes in the status of these variables?

The concept of elasticity is widely used in economics to describe the fluctuations of demand for goods and services in response to changes in price (Andreyeva, Long, & Brownell, 2010; DeCicca & Kenkel, 2015). In the Mathematical Theory of Elasticity, the focus of a calculation is to estimate the relative shift in the form of an object whose

properties are variable due the actions of equilibrating forces from external stimuli (Love, 2013). The current study applies the term elasticity to refer to the magnitude of temporal decrease or increase in the level of marital fertility rates in association with changes in sample distributions and changes in individual- and community-level reproductive behaviours. Methodologically, we differentiate this study from the existing literatures by analysing an age-adjusted indicator of fertility (age-specific marital fertility rates—ASMFRs) which is consistent with total marital fertility rates (TMFRs). Many studies have treated the average number of children ever born (CEB) as a proxy measure for TFRs despite that the two may not be consistently associated. We show proof of this in Figs. 4 and 5 presented in the Appendix. Furthermore, the analysis of ASMFRs provides consistency between the evidence of marital fertility transition (Fig. 2) and the subsequent multivariate estimations. We also differentiate this study by analysing the relative contributions to fertility change of male and female variables in a single multivariate framework. Previous studies Dodoo (1998) and Ezeh (1992) which analysed male and female correlates sought to explain the contraceptive use dynamics while the current aim was to link to actual fertility.

Conceptual framework

The conceptual framework for this study was adapted from the demographic transition theory (DTT), ideational change theory, the model of proximate determinants (PD) and past studies. Almost all the variables analysed in the study were drawn from these theories. The DTT and ideational change theories were relevant for their temporal view of fertility and informed the selection of the background factors. The PD model was instrumental in the conceptual formulation of how the different classes of independent variables affect fertility as well as guiding the selection of the relevant direct determinants. Based on the three theories and existing literature, the conceptual model shown in Fig. 1 guided the empirical multivariate modelling of the temporal change in marital fertility rates. The red arrows denote the theoretical postulations pertaining the relationships between fertility and the

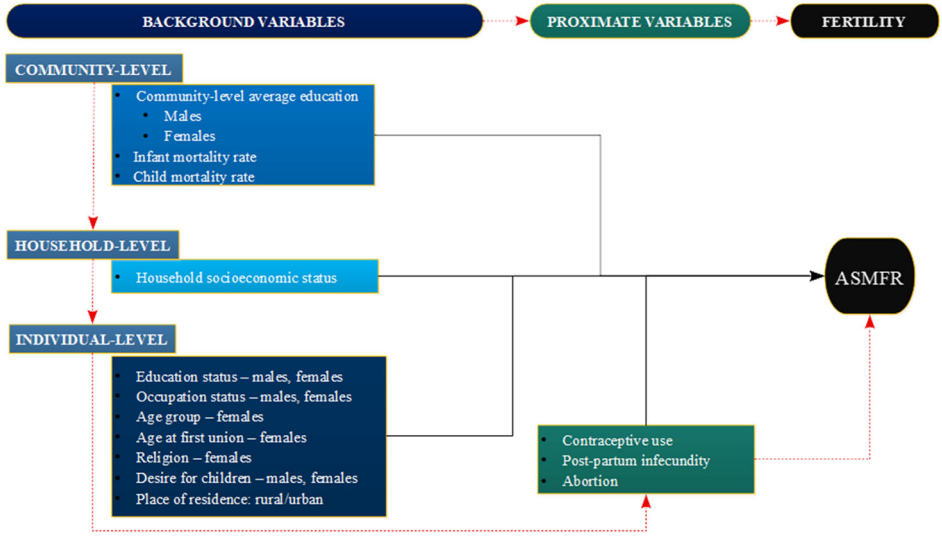

Fig. 1 Conceptual framework adapted from the DTT, ideational change and PD theories

proximate and background variables. They also show how fertility is related to the various background determinants from different levels as demonstrated in the literature (Billy & Moore, 1992; Casterline, 1981; Kravdal, 2002, 2012; McNay, Arokiasamy, & Cassen, 2003; Parr, 1992). The solid black arrows indicate the empirical modelling of marital fertility in the current study. The Oaxaca-Blinder decomposition was implemented as a multivariate model to obtain adjusted effects.

Methodology

Data

This study analysed DHS data from Kenya, Rwanda and Zimbabwe. The surveys were collected with funding from the United States Agency for International Development (USAID) and implemented by host countries' statistical agencies with technical support from the Inner-City Fund (ICF) Macro International Inc., widely cited as ICF International. The collection of DHS data has been undertaken at 5 to 6-year intervals since inception in some countries like Kenya and Zimbabwe and therefore provide consistent source of data for tracking changes in fertility rates over time. The regular time intervals of DHS surveys allow for the investigation of the impact of changing compositional characteristics of populations and their reproductive behaviours on fertility outcomes. The impactful short-term fluctuations in the properties of the macroenvironment like political and socioeconomic instabilities which affect the family planning infrastructure, for instance availability of contraception, can be captured through examining the DHS data.

Variables

The dependent variable was marital fertility which was operationalised as ASMFRs. The ASMFR describes the number of live births per woman at any given age or age group during their reproductive career given that they remain in a union from 15 to 49 years. The TMFR is derived from ASMFRs and refers to the total number of live births that a woman will give birth to by the end of her reproductive career if she remained married and experienced given ASMFRs. The choice of ASMFRs ahead of measures of cumulative parities like children ever born (CEB) was predicated on two related reasons. The first reason was that a measure of fertility like CEB may not consistently reflect the temporal decreases and increases in fertility rates. We explored this and provide a detailed illustration in the Appendix (Figs. 4 and 5). Consequently, an age-adjusted measure of fertility was justifiably preferable. The second reason was that fertility trends of countries which as cited in policy motivations are usually reported based on age-adjusted estimates but the CEB measure is not adjusted for age. In order for scientific inquiry to address both academic and policy questions regarding the correlates of the persistent high fertility rates in SSA, it is pertinent that empirical investigations generate evidence based on measures of fertility that speak to TFRs and TMFRs. The independent variables were contraceptive use, postpartum infecundity, abortion, education, occupation/employment status, husband's desire for children, religion, household socioeconomic status (SES), place of residence, religious beliefs and age group. The variables education and employment status were analysed for both wife and husband. The relevance of these independent variables was drawn from the reviewed

literature and established theories of fertility which showed their importance on fertility rates (Agadjanian & Yabiku, 2014; Bakibinga et al., 2016; Balbo, 2015; Bianchi, 2014; Bongaarts, 2015; Mturi & Joshua, 2011).

Statistical analysis

The analysis of the data involved three main parts. The first part involved the application of a Poisson regression-based direct estimation technique to birth history data for women in unions for the calculation of ASMFRs and TMFRs. The use of Poisson regression for computing fertility rates from DHS data has already been demonstrated (Schoumaker, 2013; Schoumaker & Hayford, 2004). In this study, the expected number of births when married for the duration of the reproductive period was expressed as a logarithm linked to a linear function of age group such that

$$TMFR = 5 \times \left(\exp[\alpha] + \sum\nolimits_{k=20-24}^{40-49} \exp[\alpha + b_k] \right) \quad (1)$$

where α is a constant term and b is the intercept. Given that TMFR is obtained by multiplying ASMFRs by 5, obtaining age-specific rates using Poisson regression involved exponentiating the sum of the constant term and the regression coefficients for the respective age groups which were obtained from

$$\lambda_i = \exp\left[\alpha + \sum\nolimits_{k=20-24}^{45-49} b_k A_{ki}\right] \quad (2)$$

for which A_{ki} are dummy variables for 5-year age groups from 20–24 to 45–49 years; the 15–19-year age group was used as the reference category (Schoumaker, 2013). The trends in TMFRs were reconstructed based on this same method and were computed to provide a visual aid in the illustration of the extent to which TMFRs dominated national trends in TFRs during critical periods like those of rapid declines and stalling. The first task was carried out in Stata version 14.2 using Schoumaker's (2013) *tfr*2 command.

The second part of the analysis pertained to the execution of statistical tests of significance of the trends in the TMFRs using linear regression whereby annual TMFRs for distinct periods were regressed against time in single calendar years. The distinct periods were visually determined based on the trends obtained from the preceding phase. These periods were distinguished based on continuous relatively smooth trend, for example, a period of rapid decline as opposed to one of slow fertility decline or increase in fertility. The technique of applying linear regression to test the statistical significance of the slopes was demonstrated by Garenne (2011). Adapting Garenne's (2011) formulation, the trends were tested as follows:

$$\Delta \mathrm{TMFR}_{15-49} = \alpha + \beta \times t \quad (3)$$

where $\Delta \mathrm{TMFR}_{15-49}$ denotes the temporal changes in the marital fertility rates for women aged 15–49 years, α is a constant, β represents the slope or extent of the annual decrease or increase in fertility and t stands for time in calendar years. The tests of slopes were implemented in Microsoft (MS) Office Excel 2016 on the estimates exported from Stata.

The last part of data analysis applied the Oaxaca-Blinder decomposition method. The Oaxaca-Blinder decomposition is a regression-based technique for partitioning the

difference in a distributional statistic between two groups into an 'explained' and an 'unexplained' part (Fortin, Lemieux, & Firpo, 2011). The explained part of the decomposition refers to the difference in the outcome statistic which is attributable to group distributional differences (Jann & Zurich, 2008). The unexplained portion arises from differences in how the predictor (independent) variables are associated with the outcome which is represented by the distributional statistic such as the mean (Jann & Zurich, 2008). There would always be this unexplained portion even if the first group was to attain the same average levels of measured predictor variables as the second group. This is because it also captures the effects of unobservable variables reported in the form of a constant (Jann & Zurich, 2008; Sen, 2014). The Oaxaca-Blinder method is frequently used in economics where it was originally developed to examine income differences between advantaged and disadvantaged groups. Taking DHS1 to represent the base survey and DHS2 to represent the succeeding survey, this study decomposed change in the average ASMFR over time as follows:

$$\begin{aligned}\Delta\text{ASMFR} = {} & \{E(X_{\text{DHS1}}) - E(X_{\text{DHS2}})\}' \beta_{\text{DHS2}} + E(X_{\text{DHS2}})' (\beta_{\text{DHS1}} - \beta_{\text{DHS2}}) \\ & + \{E(X_{\text{DHS1}}) - E(X_{\text{DHS2}})\}' (\beta_{\text{DHS1}} - \beta_{\text{DHS2}})\end{aligned} \tag{4}$$

where

$\{E(X_{\text{DHS1}}) - E(X_{\text{DHS2}})\}' \beta_{\text{DHS2}}$ The explained part, the change in average ASMFRs (means) that was due to group differences in the predictors, that is, the endowment effect weighted by the coefficients of later DHS

$E(X_{\text{DHS2}})' (\beta_{\text{DHS1}} - \beta_{\text{DHS2}})$ The contributions of differences in the coefficients and intercepts, shows expected outcome in earlier survey if it had later DHS survey's coefficients,

$\{E(X_{\text{DHS1}}) - E(X_{\text{DHS2}})\}' (\beta_{\text{DHS1}} - \beta_{\text{DHS2}})$ Be an interaction term accounting for the fact that the differences in the endowments and coefficients of the two successive DHS samples exist simultaneously,

E Mean of the predictor variables [adapted from Jann & Zurich, 2008]

The rationale behind this decomposition method can be applied to the study of fertility changes over time. It was applied in the current study as a counter-factual decomposition whereby the obtained results were conditional. The results were conditional on other factors remaining constant; for example, the result for contraceptive use was conditional on all the other independent variables remaining unchanged between the two successive surveys.

Results

Temporal changes in sample distribution

The three countries have experienced some long-term significant transformations in the compositional characteristics of the married samples (Table 1). The use of modern contraceptives steadily increased for all the countries with prevalence rates highest in Zimbabwe and lowest in Rwanda. All the countries have had decreases in the proportions who were breastfeeding and thus infecund at the time of survey collection with Rwanda showing the largest long-term decrease. These changes signified decreases in childbearing rates. There were limited changes with respect to practice of abortion which remained constant in Kenya and barely changed in Rwanda and Zimbabwe. The lack of increase in proportions reporting abortion

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time

	KDHS1989			KDHS1993			KDHS1998			KDHS2003			KDHS2008			KDHS2014		
	n = 4778			*n* = 4583			*n* = 4847			*n* = 4876			*n* = 5041			19,036		
	Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI	
Contraceptive use																		
None	72.5	70.8	74.2	67.1	65.6	68.7	60.9	59.3	62.4	60.5	59.0	62.0	54.0	52.0	56.0	41.5	40.2	42.9
Modern	18.4	16.9	19.8	27.4	26.0	28.9	31.6	30.1	33.1	31.6	30.2	33.1	40.0	38.0	42.0	53.8	52.4	55.1
Traditional	9.2	8.0	10.3	5.4	4.7	6.2	7.5	6.6	8.4	7.9	7.0	8.7	6.0	5.0	7.1	4.7	4.1	5.3
Postpartum infecund																		
No	57.0	55.2	58.8	62.1	60.5	63.7	65.2	63.6	66.7	62.0	60.5	63.5	65.8	63.9	67.7	68.7	67.4	70.0
Yes	43.0	41.2	44.8	37.9	36.3	39.5	34.8	33.3	36.4	38.0	36.5	39.5	34.2	32.3	36.1	31.3	30.0	32.6
Ever aborted																		
No							88.6	87.6	89.6	85.5	84.4	86.6	87.2	86.0	88.4	87.3	86.3	88.2
Yes							11.4	10.4	12.4	14.5	13.4	15.6	12.8	11.6	14.0	12.7	11.8	13.7
Age group																		
15–19	5.8	4.9	6.6	5.7	4.9	6.4	5.9	5.1	6.6	6.8	6.0	7.6	4.3	3.5	5.1	3.5	3.0	4.0
20–24	17.4	16.1	18.8	20.3	19.0	21.6	19.6	18.3	20.8	19.7	18.4	20.9	19.4	17.8	21.0	16.7	15.6	17.8
25–29	23.6	22.0	25.1	21.7	20.3	23.0	22.2	20.9	23.6	21.5	20.3	22.8	22.1	20.4	23.9	25.1	23.8	26.3
30–34	17.4	16.0	18.8	19.8	18.5	21.1	17.0	15.8	18.2	17.7	16.5	18.9	19.7	18.0	21.3	19.8	18.7	21.0
35–39	16.2	14.8	17.7	13.8	12.7	15.0	17.3	16.1	18.5	14.0	12.9	15.1	14.1	12.7	15.4	15.7	14.7	16.7
40–44	11.9	10.7	13.2	11.2	10.2	12.3	10.6	9.6	11.6	12.4	11.4	13.5	11.1	9.8	12.4	10.5	9.6	11.3
45–49	7.7	6.7	8.7	7.5	6.6	8.4	7.4	6.6	8.2	7.9	7.0	8.7	9.4	8.3	10.4	8.7	8.0	9.5
Female education																		
None	31.2	29.5	33.0	22.6	21.2	24.0	14.1	13.0	15.2	15.4	14.3	16.5	10.6	9.5	11.6	9.0	8.4	9.6
Primary	51.5	49.6	53.3	56.2	54.5	57.8	58.1	56.6	59.7	58.4	56.9	59.9	58.9	56.9	60.9	54.2	52.7	55.6
Secondary	16.9	15.6	18.2	20.7	19.4	22.1	25.5	24.0	26.9	20.7	19.4	21.9	23.7	21.8	25.6	27.2	25.9	28.6

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time *(Continued)*

Tertiary	0.3	0.2	0.5	0.5	0.3	0.8	2.3	1.7	2.8	5.5	4.8	6.2	6.8	5.9	7.7	9.6	8.7	10.5
Female occupation																		
Not employed	90.0	88.9	91.0	45.2	43.6	46.9	37.7	36.1	39.2	31.3	29.8	32.7	33.1	31.2	35.0	25.2	24.0	26.5
Skilled (employed 1988)	10.0	9.0	11.1	7.4	6.5	8.3	7.7	6.9	8.6	5.1	4.5	5.8	25.3	23.5	27.0	10.6	9.6	11.5
Semiskilled				20.0	18.7	21.3	18.4	17.2	19.7	19.0	17.8	20.3	9.3	8.0	10.6	9.9	9.0	10.7
Agriculture				25.2	23.8	26.6	33.6	32.1	35.2	38.4	36.9	40.0	29.1	27.4	30.9	28.2	27.0	29.4
Unskilled				2.1	1.6	2.6	2.5	2.0	3.0	6.1	5.4	6.9	3.1	2.3	3.9	26.1	24.8	27.4
Religion																		
Catholic	34.7	32.9	36.5	30.7	29.2	32.2	27.4	26.0	28.9	24.2	22.8	25.6	20.6	19.0	22.2	19.4	18.2	20.5
Other Christian	57.2	55.3	59.0	59.9	58.2	61.5	64.6	63.1	66.2	65.1	63.7	66.6	68.7	66.9	70.5	71.7	70.5	73.0
Muslim	3.4	2.8	4.1	4.8	4.1	5.5	5.0	4.3	5.7	8.2	7.5	8.9	7.8	7.0	8.6	6.7	6.2	7.3
None	3.1	2.4	3.7	3.7	3.1	4.3	2.1	1.7	2.5	2.2	1.8	2.6	2.4	1.9	2.9	1.8	1.5	2.1
Other religions	1.6	1.1	2.1	1.0	0.7	1.3	0.9	0.6	1.2	0.3	0.1	0.5	0.6	0.4	0.8	0.4	0.2	0.5
Household SES																		
Poorest				19.8	18.5	21.1	21.3	19.9	22.6	19.3	18.1	20.5	17.1	15.8	18.5	16.7	15.8	17.5
Poorer				20.9	19.6	22.2	19.6	18.4	20.9	19.3	18.1	20.6	18.0	16.5	19.5	17.9	16.9	18.9
Middle				18.8	17.6	20.1	18.7	17.5	19.9	18.7	17.4	19.9	19.4	17.9	20.9	19.2	18.1	20.3
Richer				19.6	18.3	21.0	18.9	17.7	20.2	19.5	18.2	20.8	20.6	19.0	22.2	21.6	20.4	22.8
Richest				20.8	19.5	22.2	21.5	20.1	22.8	23.2	21.9	24.5	24.9	22.9	26.8	24.7	23.3	26.0
Place of residence																		
Rural				85.3	84.1	86.5	79.2	77.9	80.6	77.8	76.6	79.1	76.5	74.6	78.5	60.8	59.3	62.2
Urban				14.7	13.5	15.9	20.8	19.4	22.1	22.2	20.9	23.4	23.5	21.5	25.4	39.2	37.8	40.7
Husband's education																		
None	16.3	14.8	17.7	12.2	11.1	13.3	8.4	7.5	9.3	10.8	9.9	11.8	7.7	6.8	8.6	6.6	6.1	7.1
Primary	50.9	49.1	52.8	52.3	50.7	54.0	49.0	47.4	50.6	49.5	47.9	51.0	48.5	46.5	50.6	48.2	46.8	49.6

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time *(Continued)*

Secondary	31.2	29.5	32.9	33.7	32.2	35.3	37.5	35.9	39.1	29.6	28.2	31.0	33.0	31.0	35.0	31.4	30.1	32.7
Tertiary	1.6	1.2	2.0	1.8	1.3	2.2	5.1	4.3	5.8	10.1	9.1	11.0	10.7	9.6	11.9	13.9	12.8	14.9
Husband's occupation																		
Not employed	2.1	1.5	2.6	2.1	1.6	2.5	2.9	2.3	3.4	0.8	0.5	1.0	0.4	0.2	0.6	1.3	1.0	1.6
Skilled	25.0	23.4	26.6	27.5	26.0	29.0	21.1	19.7	22.4	15.4	14.3	16.5	40.1	38.1	42.0	28.3	27.0	29.6
Semiskilled	30.2	28.5	31.8	23.3	21.9	24.7	23.6	22.3	25.0	23.4	22.1	24.7	9.6	8.3	10.9	7.7	6.9	8.4
Agriculture	36.7	34.8	38.5	35.2	33.7	36.8	33.6	32.1	35.1	34.9	33.4	36.4	30.7	28.9	32.6	22.0	21.0	23.1
Unskilled	6.1	5.2	7.0	11.9	10.8	12.9	18.9	17.6	20.1	25.5	24.1	26.8	19.2	17.6	20.8	40.7	39.3	42.1
Husband's desire for children																		
Same				55.1	53.5	56.7	57.1	55.5	58.6	50.0	48.5	51.6	57.0	55.0	59.0	58.7	57.3	60.1
More				38.1	36.5	39.7	33.9	32.4	35.4	39.8	38.3	41.4	37.3	35.3	39.2	33.4	32.1	34.7
Less				6.8	6.0	7.6	9.0	8.1	9.9	10.1	9.2	11.1	5.7	4.9	6.6	7.9	7.1	8.7
Community-level variables																		
IMR	61	60	62	61	60	62	73	71	74	76	75	77	51	51	52	39	39	39
CMR	91	89	92	96	94	97	110	108	112	112	110	114	72	71	74	52	52	52
Community education F	18.8	18.2	19.3	22.5	21.9	23.1	27.6	26.9	28.3	26.5	25.8	27.1	32.9	32.0	33.8	40.7	40.0	41.4
Community education M	32.3	31.6	32.9	34.8	34.0	35.6	42.0	41.2	42.9	39.6	38.8	40.4	43.6	42.5	44.6	45.8	45.0	46.6
	RDHS1992			RDHS2000			RDHS2005			RDHS2010			RDHS2014					
	n = 3698			*n* = 4891			*n* = 5458			*n* = 6834			*n* = 6890					
	Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI				
Contraceptive use																		
None	78.8	77.5	80.2	87.3	86.2	88.4	82.7	81.7	83.8	48.4	47.1	49.6	46.7	45.5	47.9			
Modern	12.9	11.8	14.0	5.3	4.6	6.0	10.2	9.3	11.0	45.2	44.0	46.5	47.5	46.3	48.8			
Traditional	8.3	7.4	9.2	7.4	6.5	8.2	7.1	6.4	7.8	6.4	5.8	7.0	5.8	5.2	6.3			

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time *(Continued)*

Postpartum infecund															
No	37.7	36.0	39.3	41.9	40.3	43.5	39.0	37.6	40.3	48.6	47.4	49.8	54.6	53.4	55.9
Yes	62.3	60.7	64.0	58.1	56.5	59.7	61.0	59.7	62.4	51.4	50.2	52.6	45.4	44.1	46.6
Ever aborted															
No				79.5	78.1	80.8	79.1	77.9	80.3	80.8	79.8	81.7	80.5	79.5	81.5
Yes				20.5	19.2	21.9	20.9	19.7	22.1	19.2	18.3	20.2	19.5	18.5	20.5
Age group															
15–19	3.1	2.5	3.7	3.4	2.8	4.0	1.2	0.9	1.5	1.3	1.0	1.6	1.2	0.9	1.5
20–24	16.3	15.1	17.6	18.2	16.9	19.4	18.0	16.9	19.1	14.5	13.6	15.3	12.7	11.8	13.5
25–29	21.2	19.9	22.6	21.9	20.5	23.2	22.7	21.5	23.9	25.7	24.6	26.8	22.6	21.5	23.6
30–34	22.4	21.0	23.8	18.1	16.8	19.3	20.3	19.1	21.4	21.2	20.2	22.2	24.3	23.2	25.3
35–39	16.0	14.8	17.2	16.7	15.4	17.9	14.7	13.7	15.7	16.1	15.2	17.0	17.8	16.8	18.7
40–44	12.8	11.7	13.9	13.4	12.3	14.5	13.3	12.3	14.2	11.3	10.5	12.0	12.8	12.0	13.7
45–49	8.1	7.2	9.0	8.5	7.6	9.4	9.8	9.0	10.7	10.0	9.3	10.7	8.6	7.9	9.3
Female education															
None	45.9	44.3	47.6	37.0	35.4	38.6	29.5	28.2	30.8	19.6	18.7	20.6	16.5	15.6	17.5
Primary	48.7	47.0	50.4	54.4	52.7	56.0	62.0	60.6	63.4	69.9	68.7	71.0	70.5	69.3	71.6
Secondary	5.2	4.5	5.9	8.3	7.4	9.2	8.0	7.2	8.7	9.0	8.3	9.7	10.3	9.6	11.1
Tertiary	0.2	0.1	0.3	0.3	0.1	0.5	0.5	0.4	0.7	1.5	1.2	1.8	2.7	2.3	3.1
Female occupation															
Not employed	2.2	1.8	2.6	0.3	0.1	0.4	18.8	17.7	19.9	9.7	9.0	10.4	5.8	5.2	6.4
Skilled	2.4	1.9	2.9	3.4	2.8	4.0	2.6	2.2	3.1	3.8	3.3	4.3	5.3	4.8	5.8
Semiskilled	2.0	1.6	2.4	5.0	4.3	5.7	4.2	3.6	4.7	6.5	5.9	7.1	10.8	10.1	11.6

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time *(Continued)*

Agriculture	93.2	92.5	94.0	91.0	90.1	91.9	73.4	72.1	74.6	77.1	76.1	78.1	75.9	74.9	77.0
Unskilled	0.1	0.0	0.2	0.3	0.2	0.5	1.0	0.8	1.3	2.9	2.5	3.3	2.1	1.8	2.5
Religion															
Catholic							46.6	45.2	48.0	42.1	40.9	43.3	38.0	36.8	39.2
Protestant							36.8	35.5	38.2	40.3	39.1	41.5	45.9	44.6	47.1
Adventist							13.1	12.2	14.1	14.3	13.5	15.2	12.8	12.0	13.7
Muslim							1.7	1.4	2.1	1.4	1.2	1.7	2.1	1.7	2.4
Other religions							0.8	0.6	1.1	1.0	0.8	1.3	0.8	0.6	1.0
None							0.9	0.6	1.1	0.8	0.6	1.1	0.4	0.2	0.5
Household SES															
Poorest	22.7	21.3	24.1	37.5	35.9	39.1	20.7	19.6	21.9	19.5	18.5	20.4	18.9	17.9	19.8
Poorer	20.4	19.0	21.8	12.4	11.3	13.5	20.4	19.3	21.6	20.1	19.2	21.1	21.0	20.0	22.1
Middle	19.8	18.4	21.1	19.6	18.4	20.9	20.3	19.1	21.5	20.4	19.4	21.3	20.8	19.8	21.8
Richer	18.7	17.4	20.0	15.2	14.0	16.3	20.9	19.8	22.1	20.6	19.6	21.6	19.8	18.8	20.8
Richest	18.4	17.1	19.6	15.3	14.1	16.4	17.6	16.6	18.7	19.4	18.5	20.4	19.5	18.6	20.5
Place of residence															
Rural	95.0	94.6	95.4	89.5	88.5	90.5	87.0	86.1	87.8	86.7	85.9	87.5	82.9	82.0	83.8
Urban	5.0	4.6	5.4	10.5	9.5	11.5	13.0	12.2	13.9	13.3	12.5	14.1	17.1	16.2	18.0
Husband's education															
None	33.2	31.6	34.8	33.4	31.9	35.0	26.9	25.7	28.2	19.3	18.3	20.3	16.9	16.0	17.9
Primary	60.6	59.0	62.3	56.3	54.7	57.9	61.6	60.2	63.0	68.0	66.8	69.1	70.3	69.2	71.5
Secondary	5.5	4.8	6.2	9.3	8.3	10.2	10.4	9.5	11.2	10.6	9.8	11.3	9.2	8.5	9.9
Tertiary	0.7	0.5	0.9	1.0	0.7	1.3	1.1	0.8	1.4	2.2	1.8	2.5	3.5	3.1	3.9

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time *(Continued)*

Husband's occupation																		
Not employed	0.4	0.2	0.6	0.8	0.5	1.1	0.1	0.0	0.2	0.9	0.7	1.2	0.9	0.7	1.1			
Skilled	8.9	7.9	9.8	13.0	11.9	14.1	12.9	12.0	13.9	14.5	13.6	15.3	20.2	19.2	21.2			
Semiskilled	4.3	3.7	4.9	4.1	3.5	4.8	4.9	4.3	5.5	8.2	7.5	8.8	10.0	9.3	10.7			
Agriculture	81.8	80.5	83.0	80.8	79.6	82.1	77.4	76.2	78.5	70.5	69.4	71.6	62.9	61.7	64.1			
Unskilled	4.7	4.0	5.4	1.2	0.8	1.5	4.7	4.1	5.3	5.9	5.4	6.5	6.0	5.4	6.6			
Husband's desire for children																		
Same	71.3	69.8	72.8	38.4	36.8	40.0	38.6	37.3	40.0	59.3	58.1	60.5	60.5	59.3	61.7			
More	15.6	14.4	16.8	53.4	51.8	55.0	42.9	41.4	44.3	23.5	22.5	24.6	22.1	21.1	23.1			
Less	13.1	12.0	14.2	8.2	7.3	9.1	18.5	17.4	19.6	17.2	16.3	18.1	17.4	16.5	18.4			
Community-level variables																		
IMR	85	85	86	107	107	108	86	86	87	50	50	50	32	32	32			
CMR	151	150	152	197	195	198	153	152	154	75	75	76	50	50	50			
Community education F	6.9	6.6	7.2	7.9	7.6	8.3	8.2	7.9	8.5	14.7	14.4	15.1	21.3	21.0	21.7			
Community education M	6.1	5.8	6.3	10.4	9.9	10.8	11.4	11.0	11.8	12.7	12.3	13.1	12.7	12.3	13.1			
	ZDHS1988			ZDHS1994			ZDHS1999			ZDHS2005-2006			ZDHS2010-2011			ZDHS2015		
	n = 2973			*n* = 3469			*n* = 4203			*n* = 6154			*n* = 6543			*n* = 6015		
	Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI		Mean	95% CI	
Contraceptive use																		
None	57.2	55.3	59.0	50.4	48.6	52.2	50.3	48.6	52.0	46.7	45.2	48.2	47.2	45.9	48.6	33.0	31.6	34.4
Modern	36.4	34.7	38.2	43.8	42.0	45.6	46.9	45.2	48.6	51.8	50.4	53.3	51.7	50.4	53.1	66.0	64.6	67.4
Traditional	6.4	5.5	7.3	5.8	5.0	6.6	2.8	2.3	3.4	1.5	1.2	1.8	1.1	0.8	1.4	1.0	0.7	1.3
Postpartum infecund																		
No	67.9	66.2	69.6	71.8	70.2	73.4	74.9	73.4	76.3	75.0	73.7	76.4	73.3	72.1	74.5	74.3	73.0	75.6

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time *(Continued)*

Yes	32.1	30.4	33.8	28.2	26.6	29.8	25.1	23.7	26.6	25.0	23.6	26.3	26.7	25.5	27.9	25.7	24.4	27.0
Ever aborted																		
No				82.6	81.3	84.0	85.8	84.6	86.9	87.9	86.9	88.9	87.3	86.4	88.2	83.4	82.3	84.6
Yes				17.4	16.0	18.7	14.2	13.1	15.4	12.1	11.1	13.1	12.7	11.8	13.6	16.6	15.4	17.7
Age group																		
15–19	6.5	5.6	7.4	7.3	6.4	8.3	7.7	6.8	8.6	7.5	6.7	8.4	7.2	6.4	7.9	7.0	6.3	7.8
20–24	19.8	18.3	21.3	21.4	19.9	22.9	21.8	20.4	23.2	21.7	20.5	22.9	20.1	19.0	21.2	17.2	16.1	18.3
25–29	20.8	19.2	22.3	19.4	18.0	20.8	22.0	20.6	23.4	20.8	19.6	22.0	22.1	20.9	23.2	20.8	19.5	22.0
30–34	19.0	17.5	20.4	19.0	17.6	20.4	15.0	13.8	16.2	18.1	16.9	19.3	17.6	16.6	18.6	21.6	20.4	22.9
35–39	15.0	13.6	16.3	13.7	12.4	14.9	14.4	13.2	15.5	12.3	11.4	13.2	14.2	13.3	15.2	15.7	14.6	16.8
40–44	10.1	9.0	11.2	11.1	10.0	12.2	10.8	9.8	11.8	10.6	9.7	11.5	10.1	9.3	10.9	11.5	10.6	12.5
45–49	8.8	7.8	9.9	8.1	7.1	9.0	8.3	7.4	9.2	9.0	8.1	9.9	8.7	8.0	9.5	6.2	5.5	6.9
Female education																		
None	16.4	15.0	17.8	12.9	11.8	14.1	8.8	7.9	9.7	5.7	4.8	6.5	3.0	2.5	3.4	1.5	1.1	1.9
Primary	62.2	60.4	64.1	52.8	51.0	54.6	46.2	44.6	47.9	37.5	36.1	39.0	32.2	31.0	33.5	29.9	28.5	31.2
Secondary	20.6	19.1	22.1	32.4	30.7	34.1	42.0	40.3	43.7	53.6	52.1	55.1	60.6	59.3	62.0	62.2	60.8	63.7
Tertiary	0.7	0.4	1.0	1.9	1.4	2.5	3.0	2.4	3.6	3.2	2.7	3.7	4.1	3.6	4.7	6.4	5.7	7.2
Female occupation																		
Not employed				39.3	37.5	41.0	39.4	37.8	41.1	52.0	50.5	53.5	53.1	51.8	54.5	46.0	44.5	47.5
Skilled				16.9	15.5	18.3	12.1	11.0	13.2	8.4	7.6	9.1	4.8	4.2	5.4	8.8	7.9	9.6
Semiskilled				14.7	13.4	16.0	21.7	20.3	23.1	16.6	15.5	17.7	19.2	18.1	20.3	29.6	28.2	31.0
Agriculture				27.9	26.3	29.4	25.8	24.4	27.2	19.0	17.8	20.1	11.2	10.3	12.0	13.2	12.2	14.2
Unskilled				1.2	0.8	1.6	1.0	0.7	1.3	4.0	3.5	4.5	11.7	10.8	12.5	2.3	1.9	2.8
Religion																		
Catholic	65.7	64.0	67.5	55.1	53.4	56.9	95.7	95.0	96.4	9.5	8.6	10.3	7.4	6.7	8.1	5.5	4.8	6.2

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time *(Continued)*

Protestant	32.8	31.0	34.5	41.1	39.4	42.9	4.0	3.4	4.7	23.7	22.5	25.0	15.8	14.8	16.8	13.7	12.7	14.8
Pentecostal	1.5	1.1	2.0	3.8	3.1	4.4	0.3	0.1	0.5	16.3	15.2	17.4	19.1	18.1	20.2	22.5	21.2	23.7
Apostolic										32.3	30.8	33.7	42.2	40.9	43.6	47.0	45.5	48.5
Other Christian										5.8	5.1	6.5	7.4	6.7	8.0	4.3	3.8	4.9
Other religions										3.5	3.0	4.0	1.3	1.0	1.6	1.1	0.8	1.4
None										8.9	8.1	9.8	6.8	6.1	7.4	5.7	5.0	6.4
Household SES																		
Poorest				19.8	18.4	21.1	18.7	17.5	19.9	19.2	18.0	20.5	18.8	17.8	19.8	19.5	18.3	20.6
Poorer				16.6	15.3	17.9	17.6	16.4	18.8	18.8	17.6	20.0	19.0	18.0	20.1	19.5	18.4	20.7
Middle				19.1	17.7	20.5	18.3	17.1	19.6	18.0	16.9	19.2	19.6	18.5	20.8	17.8	16.6	18.9
Richer				22.2	20.7	23.7	23.1	21.6	24.6	23.2	22.0	24.5	22.6	21.4	23.7	22.9	21.6	24.2
Richest				22.4	20.8	24.0	22.2	20.7	23.7	20.7	19.5	21.9	19.9	18.8	21.0	20.3	19.1	21.5
Place of residence																		
Rural	68.9	67.2	70.6	69.8	68.1	71.6	63.7	62.0	65.4	65.5	64.1	66.9	66.0	64.7	67.4	66.4	65.0	67.8
Urban	31.1	29.4	32.8	30.2	28.4	31.9	36.3	34.6	38.0	34.5	33.1	35.9	34.0	32.6	35.3	33.6	32.2	35.0
Husband's education																		
None	12.0	10.8	13.2	7.5	6.6	8.4	5.7	5.0	6.5	4.3	3.6	5.0	2.5	2.1	2.9	1.4	1.1	1.8
Primary	54.6	52.8	56.5	49.1	47.3	50.9	37.0	35.5	38.6	28.5	27.1	29.9	21.0	20.0	22.1	21.6	20.4	22.8
Secondary	31.7	30.0	33.4	38.8	37.1	40.6	50.7	49.0	52.3	60.9	59.4	62.3	69.5	68.3	70.7	66.6	65.2	68.0
Tertiary	1.6	1.2	2.1	4.5	3.7	5.3	6.6	5.7	7.5	6.3	5.7	7.0	7.0	6.3	7.7	10.3	9.4	11.2
Husband's occupation																		
Not employed	2.4	1.8	2.9	2.1	1.5	2.6	11.7	10.7	12.8	6.8	5.9	7.8	13.9	13.0	14.8	15.5	14.4	16.5
Skilled	28.4	26.7	30.1	33.5	31.8	35.2	32.2	30.6	33.8	35.3	33.9	36.7	32.2	30.9	33.4	39.4	38.0	40.9
Semiskilled	23.8	22.2	25.4	23.2	21.7	24.8	25.6	24.1	27.1	21.0	19.8	22.1	16.3	15.3	17.3	26.0	24.7	27.4
Agriculture	24.2	22.6	25.8	23.9	22.4	25.4	17.3	16.1	18.5	25.6	24.3	27.0	18.5	17.4	19.5	15.0	13.9	16.0

Table 1 Changes in the distribution of the married samples of Kenya, Rwanda and Zimbabwe over time *(Continued)*

Unskilled	21.3	19.8	22.8	17.3	15.9	18.6	13.2	12.1	14.3	11.3	10.4	12.2	19.1	18.1	20.2	4.1	3.5	4.7
Husband's desire for children																		
Same				47.7	45.9	49.5	48.7	47.0	50.4	56.0	54.5	57.5	59.2	57.8	60.5	50.5	49.0	52.0
More				27.5	25.9	29.1	35.2	33.6	36.8	35.6	34.1	37.1	31.8	30.6	33.1	32.4	31.0	33.8
Less				24.8	23.3	26.4	16.1	14.8	17.3	8.4	7.6	9.2	9.0	8.2	9.8	17.1	16.0	18.2
Community-level variables																		
IMR	45	45	46	52	51	53	65	64	65	59	59	60	57	56	57	50	50	50
CMR	70	69	70	76	75	77	102	101	102	82	82	83	84	84	85	69	68	69
Community education F	29.0	28.3	29.7	40.4	39.5	41.2	50.9	50.1	51.7	60.7	59.9	61.5	67.7	67.2	68.3	70.5	69.8	71.1
Community education M	33.1	32.3	33.9	43.4	42.7	44.1	57.2	56.4	58.0	67.1	66.4	67.8	76.5	76.0	76.9	77.1	76.4	77.7

suggests that this proximate determinant was not instrumental in the marital fertility transitions of the three countries. The age structure shifts of Kenya and Rwanda pointed at long-term increase in the average age of the married women which emanates from the delay of first marriage. A different picture unfolded in Zimbabwe where the proportion 15–19 years was higher for all post-1990 surveys compared to the ZDHS1988.

There were subdued increases in female educational attainment especially for Kenya and Rwanda. Although the proportions without education decreased over the long-term from 82% having primary or less in the KDHS1989 to 63% in the KDHS2014, more than half of the married women in Kenya did not have secondary education as of the latest survey. The situation was worse in Rwanda where only 10 and 3% had secondary and tertiary education by the latest RDHS survey. Zimbabwe showed better educational attainment for women than Kenya and Rwanda. Secondary educational attainment more than tripled from the ZDHS1988 (20%) to ZDHS2015 (60%) although tertiary education status at just 6% as of the latest ZDHS survey was still very low. There were greater proportions of men with secondary and tertiary education as well as greater representation in the skilled and semiskilled occupations compared to women in all the countries. Most of the women in all the study countries were from rural areas. This means that the national trends of high TMFRs of these countries have most likely been influenced by the fertility rates of rural areas. The proportions of women with husbands who desired more children increased in Zimbabwe while Rwanda showed some increase in the proportion of women reporting that their husbands desired less children. Kenya experienced a long-term decrease in the proportion of women reporting that their husbands desired more children. This trend is potentially conducive for promoting the decline in marital fertility especially considering that Kenya's 2003 period which saw a slight increase in women whose husbands desired more children was the time of stalled fertility transition.

Trends in fertility rates and significance of slopes

The trends of fertility rates are presented in Fig. 2. The onset of marital fertility transition was followed by a period of rapid declines in TMFRs. These periods of rapid declines lasted for less than 10 years in Kenya and Rwanda and about 13 years in Zimbabwe. Kenya and Rwanda experienced rebounds in fertility rates to mark the end of the periods of rapid falls of fertility rates while Zimbabwe entered a period of slow decline. Compared to Kenya, Rwanda had a longer period of stalling before resuming fertility transition.

The stalling of marital fertility transition in Zimbabwe occurred about 22 years after the onset of fertility decline and was short-lived relative to those of Kenya and Rwanda. The trends of TFRs of the three countries were roughly related to those of TMFRs but at much lower rates of fertility, highlighting the role of non-marriage in suppressing national-level fertility rates. The tendency for TFR trends to follow the trajectories of TMFR trends also highlight the fact that marital fertility plays a dominant role in shaping transitions of fertility in SSA countries as well as perpetuating high fertility rates. The statistical tests of the strengths of the distinct episodes of the TMFR trends returned significant results as reported in Table 2.

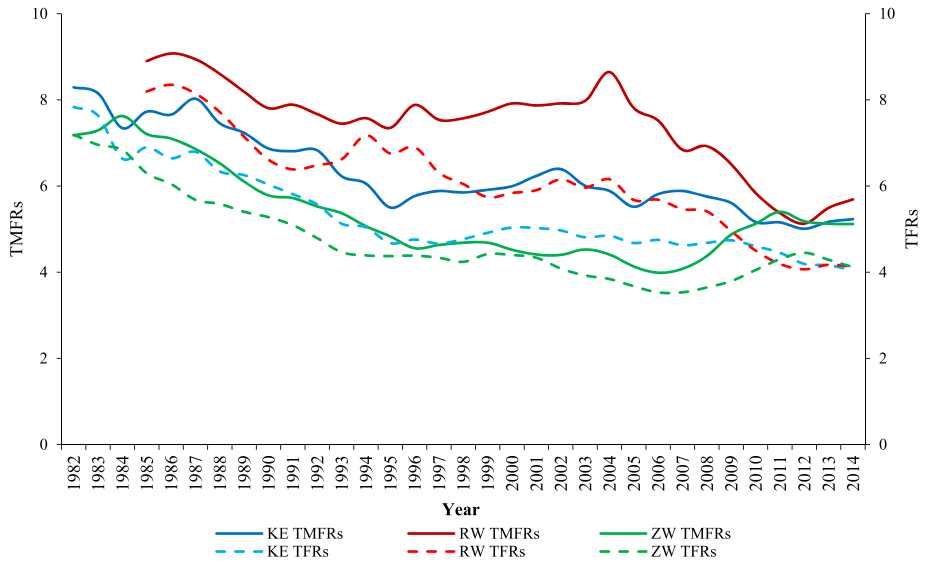

Fig. 2 Trends in TMFRs and TFRs

The time coefficients shown in Table 2 for period 1 confirm the rapid annual declines in TMFRs with Zimbabwe showing the largest decreases. The rebounds of period 2 experienced in Kenya and Rwanda represented significant increases of TMFRs with Kenya having the steepest rising trend although it was for a shorter interval of time compared to Rwanda. The overall analysis based on the entire periods covered by all the DHS

Table 2 Tests of slopes of the trends showing the marital fertility transitions of Kenya, Rwanda and Zimbabwe. Statistical significance was at $p \leq 0.05$ and is represented in the table by 95% CI (confidence interval)

			Period 1	Period 2	Period 3	Period 4	Total
			1987-1995	***1995-2002***	***2002-2014***		***1982-2014***
Kenya	TMFR	Start	8.0	5.5	6.4		8.0
		End	5.5	6.4	5.2		5.2
		Difference	-2.5	0.9	-1.2		-3.1
	Slope test	Time Coef.					-0.076
		95% CI	-0.328; -0.216	0.073; 0.142	-0.128; -0.063		-0.095; -0.057
			1986-1993	***1993-2004***	***2004-2014***		***1985-2014***
Rwanda	TMFR	Start	8.9	7.4	8.6		8.9
		End	7.4	8.6	5.7		5.7
		Difference	-1.6	1.3	-3.0		-3.2
	Slope test	Time Coef.					-0.099
		95% CI	-0.246; -0.146	0.037; 0.149	-0.412; -0.229		-0.126; 0.072
			1984-1996	***1996-2006***	***2006-2011***	***2011-2014***	***1982-2014***
Zimbabwe	TMFR	Start	7.6	4.6	4.0	5.4	7.6
		End	4.6	4.0	5.4	5.1	5.1
		Difference	-3.0	-0.6	1.4	-0.3	-2.5
	Slope test	Time Coef.					-0.075
		95% CI	-0.267; -0.230	-0.083; -0.028	0.237; 0.374	-0.239; 0.058	-0.104; -0.046

Key

	Onset, rapid decline		Reversal
	Slow decline		Resumption, slow decline
	No change		Resumption, fast decline

surveys confirmed that all the three countries have indeed undergone marital fertility transition albeit to varying magnitudes.

Decomposition of inter-survey differences in marital fertility rates

The decomposition of the temporal change in the average of ASMFRs using the Oaxaca-Blinder technique partitioned the difference in the levels of the fertility into three components measuring the conditional contributions of endowments, coefficients and interaction. The contributions were conditional because they reflect the extent to which the mean ASMFR would have increased or decreased if the country experienced a change in the respective component alone while remaining unchanged in the other components. An important consideration when interpreting decomposition results is the sign of the results. The estimation model was set to obtain the difference in the mean ASMFRs between two successive surveys by subtracting the estimate for the latest survey from that of the preceding survey. Consequently, a positive difference denoted a decrease in fertility while a negative difference represented increase in fertility. The positive conditional percentages indicate that a variable's decomposition component contributed to the observed increase or decrease in the average rate of marital fertility.

Figure 3 presents the aggregate results for endowments, coefficients, interaction and the percentage-points inter-survey decrease and increase of marital fertility. The inter-survey decreases in marital fertility in Kenya and Zimbabwe for period 1 were associated with changes in reproductive behaviour as highlighted by the positive conditional percentage for coefficients. The endowment effect played a role in reducing the magnitude of the decreases for period 2 in Kenya and Zimbabwe, but also suppressed the extent of increases during stalling periods which were periods 3 and 4 respectively. The results for Rwanda showed a different pattern from Kenya and Zimbabwe; the increase in marital fertility for the first inter-survey period was supported by all the decomposition components. The third inter-survey period for Rwanda which was the first to be marked by fertility decrease showed that both endowments and coefficients contributed to this decline. The coefficient effect would have resulted in a larger magnitude of decline between the RDHS2005 and RDHS2010. The generally small percentages for endowments compared to coefficients imply that change in reproductive behaviour played was more prominent in affecting marital fertility transition than compositional changes in the countries' populations.

Table 3 presents the detailed decomposition results for all the inter-survey periods of the three countries. There were 14 inter-survey periods analysed, and to avoid a long monotonous description of all the results, we focus on those highlighting the influence of proximate factors and male and female correlates. It is worth noting that the constants were fairly large for all the countries and that these potentially highlight the complexity of the fertility contexts of SSA countries. The constants provide a measure of the effects of variables which were not included in the analysis including factors that cannot be easily measured. Some of these factors which may have contributed to the constants are explored in the discussion. Looking at the inter-survey periods characterised by decreases in marital fertility, the changes in the coefficients of modern and none users of

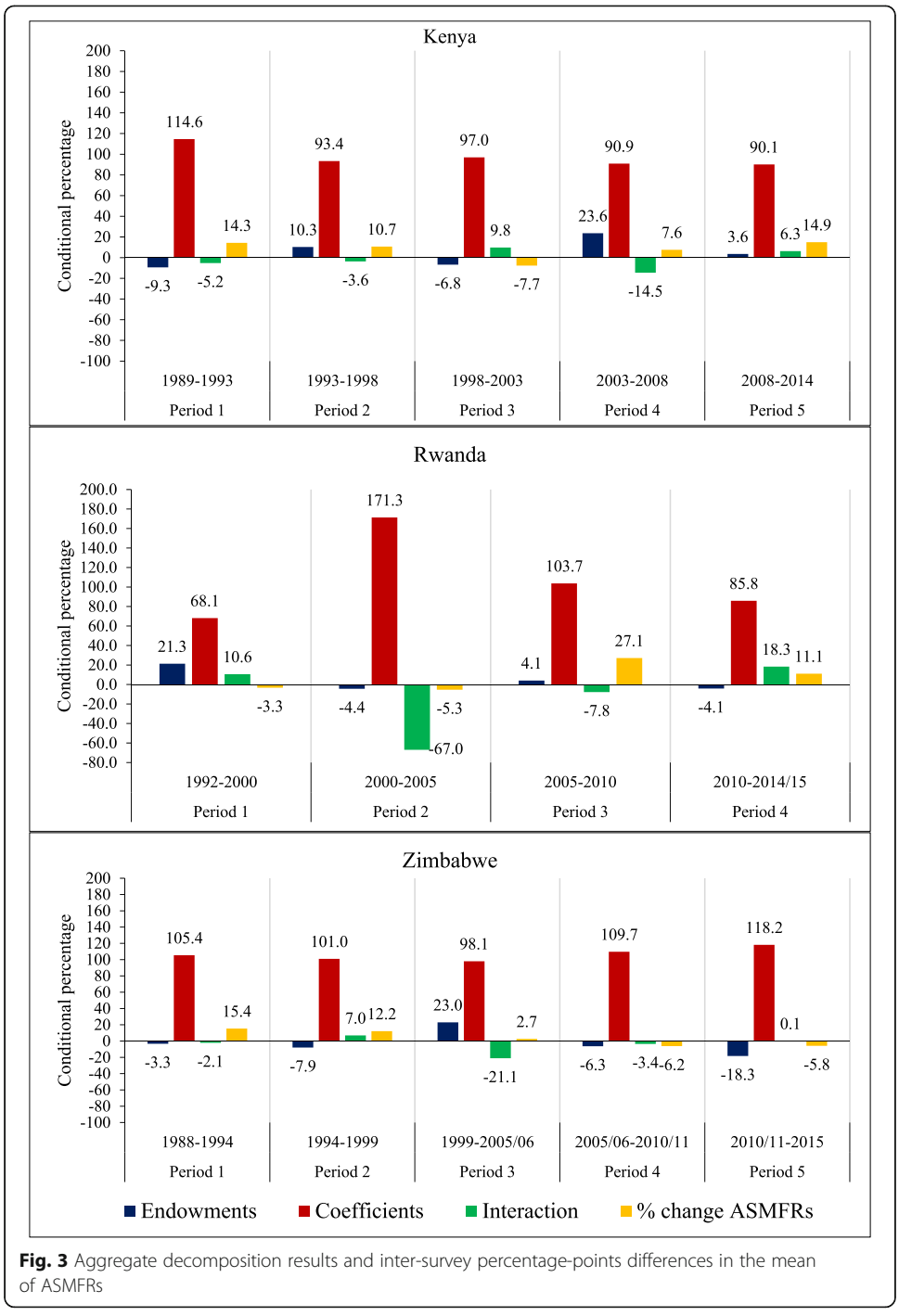

Fig. 3 Aggregate decomposition results and inter-survey percentage-points differences in the mean of ASMFRs

contraceptives, female secondary and community-level education were the prominent determinants in Kenya, for example, the 1993–1998 period. In Zimbabwe, changes in reproductive behaviour associated with the community level of education of husbands and the women as well as for 20–24-, 25–29- and 30–34-year age groups were important in the decrease of marital fertility. Compositional changes involving increases in educational attainment of women and men at the community level also contributed to the decline of marital fertility in Zimbabwe

Table 3 Detailed decomposition results of the conditional percentage contributions of the determinants' marital fertility changes

	Kenya										Rwanda							
Years ASMFR means	1989–1993 0.254–0.218		1993–1998 0.218–0.194		1998–2003 0.194–0.209		2003–2008 0.209–0.193		2008–2014 0.193–0.165		1992–2000 0.264–0.271		2000–2005 0.271–0.286		2005–2010 0.286–0.208		2008–2014/15 0.208–0.185	
	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C	E	C
Proximate																		
Contraception																		
None	0.4	− 7.0	0.3	4.3	0.0	− 4.7	0.6	− 5.1	0.2	1.4	− 0.2	− 5.7	0.2	− 2.7	0.2	− 0.8	0.1	− 1.1
Modern	− 0.5	− 1.7	0.0	2.3	0.0	− 1.0	0.0	− 0.6	0.1	0.6	− 2.5	1.5	0.4	− 1.1	− 0.5	0.0	− 0.1	0.2
Traditional	− 0.5	0.9	0.1	− 1.1	0.0	0.9	− 0.2	0.7	0.0	− 0.2	0.3	− 1.6	0.0	1.0	0.0	0.1	− 0.1	0.1
PI																		
No	0.3	− 0.1	0.2	− 0.8	0.4	− 1.4	0.1	− 5.5	0.1	2.5	− 0.7	− 6.3	0.1	2.5	0.1	0.3	0.2	− 0.2
Yes	0.3	0.1	0.2	0.4	0.4	0.9	0.1	2.8	0.1	− 1.1	− 0.7	8.8	0.1	− 3.8	0.1	− 0.3	0.2	0.2
Abortion																		
No					0.0	0.0	0.0	2.0	0.0	− 2.3			0.0	4.8	0.0	0.6	0.0	1.1
Yes					0.0	0.0	0.0	− 0.3	0.0	0.3			0.0	− 1.3	0.0	− 0.1	0.0	− 0.3
Female																		
Education																		
None	− 0.6	1.3	− 0.6	− 0.8	0.0	1.3	0.9	− 2.1	0.0	1.0	2.0	− 0.6	− 0.7	6.8	− 0.1	0.6	− 0.1	− 0.4
Primary	0.0	− 0.5	0.1	3.0	0.2	14.0	0.0	9.3	− 0.1	− 0.6	− 0.2	− 13.5	1.3	12.3	0.0	2.3	0.0	0.3
Secondary	− 0.2	1.0	0.3	3.5	− 0.5	4.4	0.0	2.7	0.0	− 0.3	1.6	3.0	0.0	− 2.0	0.0	0.0	− 0.1	− 0.1
Tertiary	0.0	0.0	− 0.4	− 0.3	− 0.7	− 3.0	0.2	− 0.5	− 0.1	− 0.9	0.0	0.0	− 0.1	− 0.1	0.0	− 0.1	0.0	0.1
Community-level education	0.7	2.8	− 0.2	− 0.3	0.0	1.7	2.5	11.2	0.5	− 6.1	1.0	17.1	0.2	− 0.3	− 0.4	0.9	− 0.1	4.1
Occupation																		
Not employed	0.5	− 0.5	0.3	0.6	− 0.1	− 1.4	0.0	1.3	0.3	− 1.4	6.5	− 0.8	0.6	37.8	0.1	− 0.1	− 0.2	0.6
Skilled	0.5	0.7	0.0	0.8	0.0	1.0	− 0.8	− 1.0	− 0.8	0.8	1.0	4.1	0.2	− 2.4	0.0	− 0.2	0.0	− 0.1
Semiskilled			0.0	0.8	0.0	− 0.7	1.4	− 1.5	0.0	0.6	4.1	7.2	− 0.1	− 2.9	0.0	0.1	0.1	0.3

Table 3 Detailed decomposition results of the conditional percentage contributions of the determinants' marital fertility changes *(Continued)*

Agriculture			0.4	2.1	0.1	3.6	− 0.8	2.7	0.0	− 1.2	− 2.1	75.3	− 1.0	− 38.0	0.0	0.6	− 0.1	6.1
Unskilled			0.0	− 0.5	0.0	− 1.3	− 0.2	0.2	0.0	− 1.1	0.0	− 0.1	0.1	0.1	0.0	0.1	0.1	− 0.4
Male																		
Education																		
None	0.1	− 0.3	− 0.3	1.0	0.0	0.8	0.4	− 1.3	0.0	0.5	0.0	− 0.5	0.4	0.3	− 0.1	0.0	− 0.2	0.8
Primary	0.0	0.1	− 0.1	− 1.0	0.1	4.7	0.0	− 0.5	0.0	1.2	1.2	− 6.4	− 0.4	5.3	− 0.1	− 1.9	0.1	6.9
Secondary	0.0	− 1.4	− 0.2	− 1.7	0.0	− 2.1	− 0.2	− 2.1	0.0	1.0	− 1.2	− 2.6	− 0.1	1.1	0.0	− 0.1	0.0	0.0
Tertiary	0.0	0.1	− 0.2	− 0.3	0.0	− 1.2	0.2	2.5	0.0	− 1.8	0.3	0.4	0.0	− 0.2	0.0	0.1	− 0.2	− 0.5
Community-level education	− 0.2	2.4	0.7	10.1	− 0.1	7.6	− 1.0	− 9.6	− 0.2	2.9	− 3.1	− 16.5	− 0.4	0.9	0.0	− 1.2	0.0	3.3
Occupation																		
Not employed	0.0	0.4	0.0	− 0.3	0.2	− 0.1	0.1	− 0.1	0.0	0.2	− 0.1	− 0.1	− 0.8	0.2	0.0	0.2	0.0	0.1
Skilled	− 0.1	− 2.7	− 0.1	1.6	− 0.3	1.2	0.7	2.8	0.2	− 1.0	− 0.6	− 5.2	0.0	− 4.0	0.0	− 1.2	− 0.1	0.0
Semiskilled	0.2	− 0.8	0.0	1.0	0.0	1.1	− 1.7	1.5	0.0	− 0.4	− 0.1	2.7	− 0.2	− 2.8	0.0	− 0.4	0.0	0.0
Agriculture	0.1	− 1.6	− 0.1	3.1	0.0	3.0	− 0.1	1.0	− 0.1	0.0	0.3	− 36.3	0.9	− 3.8	− 0.2	− 1.2	0.0	− 6.2
Unskilled	0.2	− 0.3	− 0.2	− 1.9	− 0.2	− 1.8	− 0.6	1.2	0.1	− 2.0	− 0.5	0.4	− 0.9	− 1.6	0.0	− 0.4	0.0	0.1
HDC																		
Same			0.0	0.1	− 0.1	2.6	− 0.2	0.1	0.0	0.4	0.1	1.8	0.0	− 1.2	0.0	0.1	0.0	− 1.8
More			− 0.1	0.3	0.1	2.3	− 0.1	2.7	0.0	− 0.6	0.2	6.0	− 0.2	− 1.6	− 0.2	0.3	0.0	0.0
Less			− 0.1	− 0.1	− 0.1	− 1.1	0.1	− 0.4	0.0	0.1	1.0	− 3.2	− 0.3	1.3	0.0	− 0.3	0.0	0.6
Demographic																		
Age group																		
15–19	0.3	1.7	− 1.2	− 8.4	5.0	− 8.6	14.3	0.5	3.2	− 2.3	0.5	0.7	0.9	− 1.9	− 0.1	− 1.1	0.2	0.6
20–24	− 9.3	16.7	3.9	− 8.1	0.9	11.6	2.5	2.2	10.1	14.1	21.1	29.2	− 0.9	25.5	5.0	2.0	8.1	3.4
25–29	3.4	10.0	− 1.5	4.1	− 3.3	21.8	− 2.7	5.8	− 5.7	14.2	6.6	− 21.9	6.2	31.7	− 2.7	13.0	10.6	− 8.2
30–34	− 1.1	10.8	3.8	− 10.4	1.9	3.2	− 2.3	18.4	− 0.1	3.8	− 33.7	11.4	10.8	7.3	− 0.4	9.7	− 5.3	− 2.6
35–39	− 1.5	− 3.1	8.7	26.2	10.3	11.8	0.1	− 8.6	2.3	1.8	− 0.2	− 7.5	− 2.5	21.3	0.4	8.5	1.3	− 3.9

Table 3 Detailed decomposition results of the conditional percentage contributions of the determinants' marital fertility changes *(Continued)*

40–44	− 2.3	− 1.6	− 3.1	− 0.4	− 14.2	− 4.5	− 9.5	− 5.6	− 2.4	− 2.8	− 4.6	9.8	0.7	− 24.9	− 2.1	− 2.1	6.3	7.0
45–49	− 0.8	− 13.3	− 0.7	5.9	− 6.0	− 7.7	15.9	− 2.9	− 3.1	− 6.9	− 9.6	− 14.8	− 21.6	− 11.4	0.3	− 6.1	− 9.2	− 5.0
IMR	0.0	1.8	− 1.6	6.3	− 1.2	− 43.6	12.5	− 47.4	1.9	4.8	21.5	167.2	− 12.4	0.5	1.1	4.4	− 32.7	62.1
CMR	0.6	9.9	1.4	− 20.6	0.1	21.7	− 8.7	22.2	− 2.7	0.6	4.9	− 142.0	12.9	− 54.3	3.7	− 7.6	16.8	− 25.0
Socioeconomic																		
SES																		
Poorest			0.0	− 0.4	0.1	− 1.1	0.1	− 1.3	0.0	0.1	3.8	2.6	1.6	− 5.1	0.0	− 0.5	0.0	− 0.2
Poorer			0.1	1.4	0.0	0.0	− 0.1	2.8	0.0	− 1.2	− 1.0	1.8	− 0.2	− 2.0	0.0	− 0.2	− 0.1	− 1.0
Middle			0.0	− 0.8	0.0	0.2	0.1	0.7	0.0	− 1.0	0.0	− 5.6	0.0	2.4	0.0	0.0	0.0	0.5
Richer			0.0	0.6	0.0	0.1	0.1	1.1	0.0	− 1.0	− 0.4	4.0	0.5	0.2	0.0	0.2	0.0	0.8
Richest			0.0	− 0.8	0.0	1.1	− 0.3	− 4.3	0.0	3.9	1.0	− 2.9	0.1	3.8	0.0	0.5	0.0	0.0
Religion																		
Catholic	0.0	− 1.2	0.1	0.3	0.0	− 0.9	0.0	− 0.2	0.0	0.4					0.1	− 1.7	− 0.1	2.9
Protestant															− 0.1	− 1.1	0.3	5.5
Pentecostal															0.0	− 0.2	− 0.1	1.4
Muslim	0.0	0.2	0.0	0.0	0.1	0.7	0.0	1.0	0.0	− 0.1					0.0	− 0.1	0.0	0.1
Other Christian	0.1	2.1	− 0.2	− 7.3	0.2	1.8	0.0	5.9	0.1	2.7								
Other religions	0.0	0.0	0.0	0.1	0.0	0.0	− 0.1	− 0.2	0.0	0.0					0.0	0.1	0.0	− 0.2
None	0.0	0.0	0.0	0.0	0.0	− 0.4	0.0	0.2	0.0	− 0.2					0.0	0.0	0.1	− 0.1
Place of residence																		
Rural	0.0	1.3	− 0.1	1.3	0.1	− 2.0	0.1	− 7.3	− 0.3	2.9	− 0.5	26.8	0.1	− 9.6	0.0	0.2	0.0	− 0.3
Urban	0.0	− 0.2	− 0.1	− 0.4	0.1	0.6	0.1	2.2	− 0.3	− 1.9	− 0.5	− 3.1	0.1	1.4	0.0	− 1.0	0.0	1.2
Constant		86.9		82.3		60.1		91.5		65.7		− 17.3		182.2		88.7		33.2
Total (minus_cons)																		
	Zimbabwe																	
Years	1988–1994		1994–1999		1999–2005/2006		2005/2006–2010/2011		2010/2011–2015									

Table 3 Detailed decomposition results of the conditional percentage contributions of the determinants' marital fertility changes *(Continued)*

ASMFR means	0.209–0.177		0.177–0.155		0.155–0.151		0.151–0.161		0.161–170	
	E	C	E	C	E	C	E	C	E	C
Proximate										
Contraception										
None	0.1	− 0.3	0.0	2.6	− 0.7	9.3	0.1	11.2	4.0	− 14.1
Modern	0.0	0.0	0.1	0.7	− 0.5	− 9.6	0.0	5.6	− 2.2	− 20.0
Traditional	0.0	0.0	0.1	− 0.2	0.1	0.0	0.1	− 0.4	0.0	0.7
PI										
No	0.2	0.7	0.1	− 4.0	0.1	9.8	0.4	− 7.8	− 0.1	9.8
Yes	0.2	− 0.3	0.1	1.3	0.1	− 3.3	0.4	2.8	− 0.1	− 3.4
Abortion										
No			0.0	4.4	0.6	27.4	0.1	1.7	0.0	7.5
Yes			0.0	− 0.7	0.6	− 3.8	0.1	− 0.3	0.0	− 1.5
Female										
Education										
None	− 0.1	1.3	0.0	− 0.1	− 2.6	4.1	1.0	− 0.1	0.0	0.6
Primary	0.3	0.8	0.2	1.3	2.3	− 5.4	0.5	− 7.2	0.2	0.9
Secondary	− 0.4	4.0	− 0.5	− 0.1	− 10.3	− 32.6	0.8	− 17.2	0.1	− 3.2
Tertiary	0.1	− 0.5	0.1	0.0	0.1	0.1	0.4	2.2	0.0	− 2.3
Community-level education	2.6	3.8	− 1.2	− 23.5	11.5	102.5	− 1.9	18.3	1.3	51.6
Occupation										
Not employed			0.0	− 0.9	0.5	− 3.8	0.1	7.2	− 0.8	− 0.5
Skilled			0.0	0.3	− 0.8	1.9	0.6	− 0.3	− 0.5	0.4
Semiskilled			− 0.4	− 1.3	1.6	− 0.5	0.4	0.7	2.0	0.6
Agriculture			0.2	0.2	1.0	4.6	0.0	− 0.7	0.4	2.2
Unskilled			0.0	0.1	0.7	− 1.4	− 1.0	− 0.5	3.3	− 0.5

Table 3 Detailed decomposition results of the conditional percentage contributions of the determinants' marital fertility changes *(Continued)*

Male										
Education										
None	−0.4	0.0	−0.2	−0.2	−0.1	−1.8	0.3	−0.3	0.2	−0.1
Primary	−0.2	0.2	−0.7	0.3	−1.8	−1.9	0.1	1.7	0.0	−1.3
Secondary	−0.5	−1.4	−1.0	1.4	−1.1	18.5	1.8	10.8	−0.4	−3.5
Tertiary	−0.1	0.2	−0.1	0.0	0.0	1.2	0.0	−0.8	0.4	1.8
Community-level education	1.1	9.2	5.7	13.2	−2.9	−155.6	1.3	0.7	−0.2	−38.4
Occupation										
Not employed	0.0	−0.1	−0.1	0.8	−0.2	0.9	0.1	0.5	0.0	−0.7
Skilled	−0.2	−1.8	−0.1	2.8	0.1	−7.0	0.0	0.1	0.6	3.9
Semiskilled	0.0	1.6	−0.2	−3.3	0.6	4.7	−0.4	0.3	0.1	−1.9
Agriculture	0.0	0.2	−0.7	1.3	2.1	−8.8	1.1	−0.6	1.0	−1.9
Unskilled	−0.1	0.7	0.3	−1.4	0.4	2.1	0.4	−0.5	−3.0	0.6
HDC										
Same			0.0	1.2	0.4	−3.0	0.0	1.8	0.3	−2.1
More			0.4	1.2	0.1	−4.4	0.1	0.8	0.0	−0.9
Less			0.7	−0.9	1.6	1.5	0.0	−0.5	0.8	1.2
Demographic										
Age group										
15–19	−1.9	0.1	−2.1	−13.8	5.0	21.2	−4.1	3.8	−1.4	−4.2
20–24	−5.0	3.1	−1.3	13.1	3.1	−87.2	−17.1	−6.7	−31.4	−4.0
25–29	2.5	10.2	−5.7	13.6	13.8	6.6	8.2	35.5	−10.7	37.5
30–34	0.0	3.0	−0.7	20.0	−6.5	−54.3	−0.4	−0.5	4.7	6.1
35–39	−1.0	−0.1	1.1	5.9	−23.1	39.1	−7.2	17.4	−5.4	1.7
40–44	2.9	−2.8	−1.4	1.4	−3.4	−12.6	6.2	−19.7	−16.7	0.9
45–49	−3.3	−4.7	1.1	−10.9	21.6	16.9	3.8	−9.2	39.7	−8.9

Table 3 Detailed decomposition results of the conditional percentage contributions of the determinants' marital fertility changes *(Continued)*

IMR	0.0	− 7.2	− 6.2	− 40.2	− 9.5	253.3	− 2.6	107.1	− 3.3	− 25.1
CMR	0.1	3.6	7.1	35.7	16.9	− 181.9	− 1.3	− 91.2	− 0.5	48.5
Socioeconomic										
SES										
Poorest			− 0.1	− 0.3	− 0.2	− 11.2	− 0.1	0.2	0.0	− 3.2
Poorer			0.0	0.6	− 0.1	− 4.2	0.0	− 3.8	− 0.1	− 0.3
Middle			0.0	− 0.9	− 0.1	7.1	0.1	3.6	− 0.2	0.8
Richer			0.0	− 0.3	0.0	5.0	0.0	1.1	0.0	0.6
Richest			0.0	0.9	− 0.2	4.0	0.1	− 0.8	0.0	2.3
Religion										
Catholic	− 0.3	2.2	− 0.6	− 5.4	3.2	− 147.1	− 0.1	0.6	− 0.1	0.1
Protestant							0.4	− 2.0	0.3	− 1.2
Pentecostal							− 0.2	− 4.7	− 0.5	− 1.7
Apostolic							0.8	4.2	− 0.1	− 4.2
Muslim										
Other Christian							0.1	− 1.2	0.0	− 0.3
Other religion	− 0.1	− 0.3	− 1.5	0.5	− 0.4	− 3.0	0.4	0.2	− 0.1	0.6
None	0.0	− 0.1	− 0.1	0.0	− 1.1	23.7	− 0.2	1.1	0.2	− 1.4
Place of residence										
Rural	0.0	4.1	0.0	− 3.7	0.2	6.1	0.0	5.3	0.0	3.6
Urban	0.0	− 1.8	0.0	2.1	0.2	− 3.2	0.0	− 2.7	0.0	− 1.8
Constant		77.8		86.2		274.1		42.9		86.6

PI postpartum infecundity, *HDC* husband's desire for children

as evident in the 1994–1999 period. In the case of Rwanda, the fertility-inhibiting reproductive behaviours associated with the increase in community-level female and male education, women in agriculture jobs and women whose husbands had primary education only were important in the decrease of marital fertility in Rwanda. The results (Table 3) also showed that changes in the reproductive behaviours of women in the 20–24- and 25–29-year age groups contributed for the decrease in Rwanda's fertility. There was also evidence of marital fertility declining in association with decreases in infant and child mortality in Rwanda post-2005.

The stall of marital fertility transition in Kenya (KDHS1998–KDHS2003) was positively associated with the reproductive behaviour changes of women with primary and secondary education, women involved in agriculture jobs and the 20–24-, 25–29- and 30–35-year age groups. With respect to male-related variables, the fertility behaviours of women who had primary education only and husbands who desired more children also contributed to stalling in Kenya. The results for Rwanda appeared to show a counter-intuitive picture for the 1992–2000 period. The changes in the coefficients of women using modern contraceptives, women with secondary education, those involved in agriculture occupations and those who had husbands who desired more children contributed to the 1992–2000 increase in marital fertility in Rwanda. Such results potentially highlight the lack of sufficient family planning services which hinder consistence in the access and use of contraceptives leading to contraceptive use being associated with the increase in marital fertility. The increase in marital fertility between the RDHS2000 and RDHS2005 was associated with the fertility coefficients of women who had never had an abortion, those with primary or no education, women who were not employed, those from the richest SES quantile and the 20–24-, 25–29- and 35–39-year age groups. The compositional changes involving the increased proportion of married women in the 20–24-year age group also contributed to the pre-2005 increase in marital fertility in Rwanda.

Just like Rwanda, Zimbabwe also had two inter-survey periods characterised by an increase in marital fertility, but these involved the latest surveys. In the first inter-survey period of marital fertility increase for Zimbabwe, 2005/2006–2010/2011, the results showed that reproductive behaviours of non-users of contraceptives, women who were not employed, rural residents, Apostolic women and the 25–29- and 35–39-year age groups were positively associated with the increase in marital fertility. The coefficients of women married to husbands with secondary and tertiary education and husbands in skilled occupations were also positively associated with the ZDHS2005/2006–ZDHS2010/2011 increase in marital fertility. The increase in marital fertility between the ZDHS2010/2011 and ZDHS2015 was associated with age composition changes of the female married population which became younger as the proportion 45–49 significantly decreasing while 35–39 years increased. The coefficients associated with being married to a husband with tertiary education and in skilled occupation were also positively associated with the increase in marital fertility in the last inter-survey period for Zimbabwe.

Although most of the marital fertility changes were unexplained, there were notable instances where the empirical model explained considerable proportions of the inter-survey differences in ASMFR. These are shown in Table 4.

The results in Table 4 relate to compositional changes involving the indirect factors. The model was able to explain 23% of the 2003–2008 decrease in ASMFR in Kenya. This period marked the resumption of marital fertility transition. The model also explained close to 10%

Table 4 Proportions of the changes in ASMFR explained by the model

Country	Period	Survey years	Proportion explained (%)
Kenya	1	1989–1993	9.3
	2	1993–1998	8.9
	3	1998–2003	7.5
	4	2003–2008	23.0
	5	2008–2014	2.9
Rwanda	1	1992–2000	17.4
	2	2000–2005	7.2
	3	2005–2010	4.2
	4	2008–2014/2015	4.6
Zimbabwe	1	1988–1994	3.5
	2	1994–1999	5.9
	3	1999–2005/2006	21.4
	4	2005/2006–2010/2011	8.8
	5	2010/2011–2015	19.3

of the decreases in AMSFR for Kenya's first two inter-survey periods. In Rwanda, 17% of 1992–2000 increase in ASMFR was explained. There were two instances where considerable proportions of changes in ASMFR were explained in Zimbabwe. As shown in Table 4, these were the 1999–2005/2006 decrease and 2010/2011–2015 increase in ASMFR.

Discussion and conclusion

This study found variations in the onset and nature of the trajectories of the marital fertility transitions of the three countries. These variations in the fertility trends of countries reflect differences in the national family planning environments as well as the macro environments affecting fertility (Askew et al., 2017). This potentially implies that previous findings showing marked variations of TFR trends across countries from SSA (Askew et al., 2017; Casterline, 2001) were in fact reflective of inter-country differences in marital fertility. The factors such as mass access to formal education, female labour-force participation and family planning policies have been found to determine the decreases and variability of TFRs in SSA countries (Colleran, Jasienska, Nenko, Galbarczyk, & Mace, 2014; Mbacké, 1994; Murthi, 2002; Siah & Lee, 2015). The findings from this study were consistent with those from past studies; marital fertility transition was more advanced in Zimbabwe where average educational attainment was greater than in Kenya and Rwanda. It is worth noting that education and labour-force participation are integral to the postulations of the demographic transition theory. The DTT states that development enhances labour-force participation and access to formal education which improves adoption of modern contraceptives with fertility-inhibiting effects. The adoption of modern contraceptives can be understood in terms of ideational change theory as cultural resistance to new ideas about birth control are eroded.

This study found evidence of stalling of marital fertility transitions in all the three countries with Kenya and Rwanda experiencing stalls relatively soon after fertility transition started. The stalling of marital fertility transition in Kenya, Rwanda and

Zimbabwe relates to the findings from various previous studies which investigated TFRs (Bongaarts, 2008; Garenne, 2008; Gries & Grundmann, 2015; Moultrie et al., 2008; Shapiro & Gebreselassie, 2009). The contribution of the current study is showing that the stalls of TFR transitions in these SSA countries were in fact stalls in marital fertility transitions. It has previously been shown in Zimbabwe that the fertility rates of women who were not in unions continued to decrease in the 2000s with the stalling of TFRs being influenced by rebounds in TMFRs (Ndagurwa & Odimegwu, 2019).

The results from decomposition analysis showed that very small proportions of the changes in ASMFR were explained by the model. When small proportions of fertility decrease are explained, it is because changes in the compositional characteristics of samples were not large enough to have a meaningful effect on fertility rates. In the three countries studied, the increases in employment, education, proportion urban among other characteristics were mostly small. Consequently, it was unable to explain most of the marital fertility decreases as well as stalls. The lack of substantial changes in compositional characteristics can be explained by the fact that Kenya, Rwanda and Zimbabwe did not experience significant economic development over the 1990–2015 period. This lack of development has been cited as a determinant of the stalling of fertility transitions in many SSA countries (Bongaarts, 2006; Shapiro, 2013). Having small proportions of change in ASMFR explained by the model means that most of the TMFR transitions were unexplained. The larger effects of coefficients compared to endowments indicate that the temporal changes in the reproductive behaviours of the different segments of the married women were important in the marital fertility transitions of the three countries. The greater importance of reproductive behaviour changes compared to compositional characteristics found in the current study arguably explains the parallel fertility trends for the different education categories previously reported by Garenne (2012). The longitudinal analysis of fertility rates by education status (no education, primary, secondary and tertiary) by Garenne (2012) showed that the differences in the fertility rates of women were explained by a time lag in the onset of transition. This means that family planning services which influence reproductive decisions and outcomes have been crucial to the marital fertility transitions of SSA countries.

A notable finding from the current study was the large constants which provided a measure of the effects of variables excluded from the analysis. Some of these factors are HIV/AIDS and economic crisis in Zimbabwe which affected family planning services. In Rwanda, there were social and political instabilities from the civil war of the late 1990s which arguably led to the rise in fertility. We undertook an exploratory review of the temporal changes in the preferred number of children for the married women from the three countries focusing on periods of stalling. In Ghana and Kenya, the average ideal number of children decreased in the first inter-survey period and remained virtually unchanged for all the subsequent periods. Rwanda experienced decreases in ideal number of children between the RDHS2005 and RDHS2010 only while in Zimbabwe this occurred from ZDHS1988 to ZDHS2005/06. We also explored the proportions of women desiring four or more children and found that most women expressed this desire throughout and this may explain why stalling has occurred at high levels of TFRs. The high demand for children by most women from SSA has been reported in previous research which noted this feature as a prominent characteristic historically (Tabutin, Schoumaker, & Rabenoro, 2004).

This study found complementary small conditional percentage contributions of male and female variables for periods of significant decreases of marital fertility rates, but in instances

of stalling, male variables tended to have greater conditional percentages. This means that the decreases of marital fertility in Kenya, Rwanda and Zimbabwe benefited from the congruence of male and female endowment and coefficient effects while stalling was associated with men more than women. These results echo findings from previous research which sought to examine the role of men in the fertility behaviours and outcomes for women from SSA (Dodoo, 1995; Ezeh, 1991, 1992; Hartmann et al., 2012; Kimuna & Adamchak, 2001; Mbizvo & Adamchak, 1991; Ngome & Odimegwu, 2014; Odimegwu, Bamiwuye, & Adedini, 2015). In conclusion, marital fertility transitions are underway in Kenya, Rwanda and Zimbabwe. The major determinants of these transitions lie mostly outside the vector of individual-level socioeconomic characteristics of men and women. While socioeconomic characteristics have been found to explain differences in fertility among women at a given time, it does not necessarily mean that the same variables can account for the temporal decreases or increases in marital fertility which have been experienced in Kenya, Rwanda and Zimbabwe. The importance of these variables remains relevant nonetheless.

Study limitations

One of the limitations of this study was an unbalanced set of independent variables. The lack of comparable variables for household SES, religion and abortion especially for the 1980s' surveys meant that the study was unable to undertake a full appraisal of roles of these factors throughout the period covered by DHS surveys. Another limitation relates to the derivation of community-level variables which was based on clusters which may not be synonymous with the socio-spatial patterning cultural norms which have a bearing on fertility outcomes. While the use of cluster boundaries to represent communities makes technical convenience and has been used in other studies, it is always associated with the risk of misclassification of individuals into communities they may otherwise not belong to culturally. One should therefore exercise caution when interpreting the results for community-level variables. Lastly, some variables were excluded due to the fact that the decomposition method used is best suited to analysing variables showing notable change over time. Consequently, variables like desire for children which barely changed following the first inter-survey periods were not analysed.

Policy recommendations

The findings from this study suggest that analysing male and female correlates of marital fertility can shed more light on the fertility dynamics of countries. In patriarchal societies like those mostly found in SSA, demographic problems emanate from the social structures which are characterised by unequal division of power and decision-making which are associated with the ability to determine other people's individual outcomes. It is therefore recommended that demographic research does not dissociate its objects of enquiry like fertility from the socioeconomic environments within which they are nested. The incorporation of variables that are reflective of the wider societal social organisation in future studies of fertility through the use of innovative analytical methods is recommended.

Appendix

Temporal associations of TMFRs, CEB and ASMFRs

An illustration of the advantage of ASMFRs over CEB is presented in Fig. 2. It can be observed that the trends of TMFRs and ASMFRs were parallel which is expected

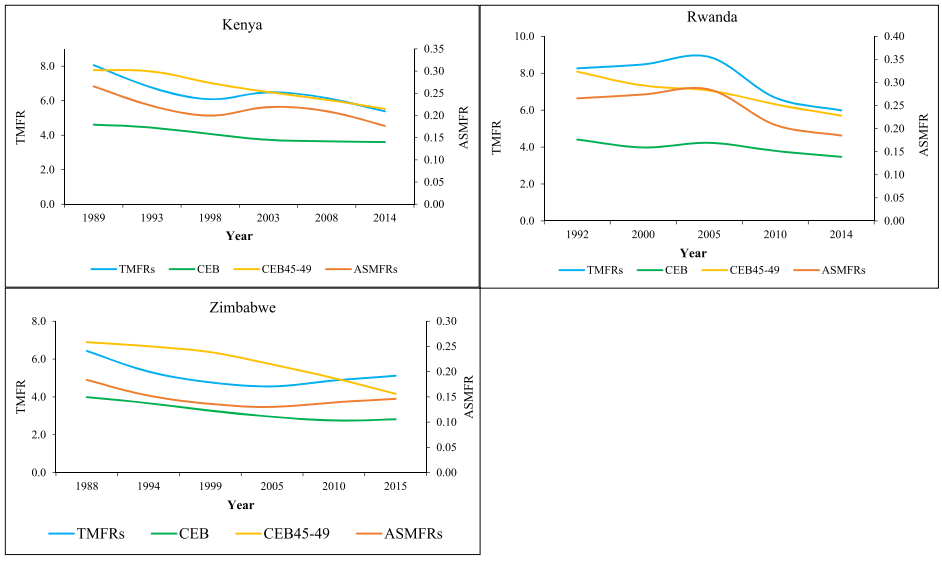

Fig. 4 Inconsistencies between CEB and TMFRs and consistencies between ASMFRs and TMFRs

because TMFRs are computed from ASMFRs. However, the trends in CEB were not parallel to those of TMFRs for all the countries. We acknowledge that it can be a critique of the comparisons in Fig. 2 that TMFRs are a pseudo cohort estimate which conceptually assumes that all the women have completed their reproductive careers since the TMFR statistic is a measure of completed fertility of pseudo cohort. To counter this, we also constructed trends of CEB for the last age group 45–49 and observed that cumulative fertility measure still fell short of predicting the true transitions of TMFRs. The results in Figs. 4 and 5 thus provide evidence to support the use of ASMFRs as the dependent variable in a study of marital fertility transition which is understood in terms of trends in TMFRs.

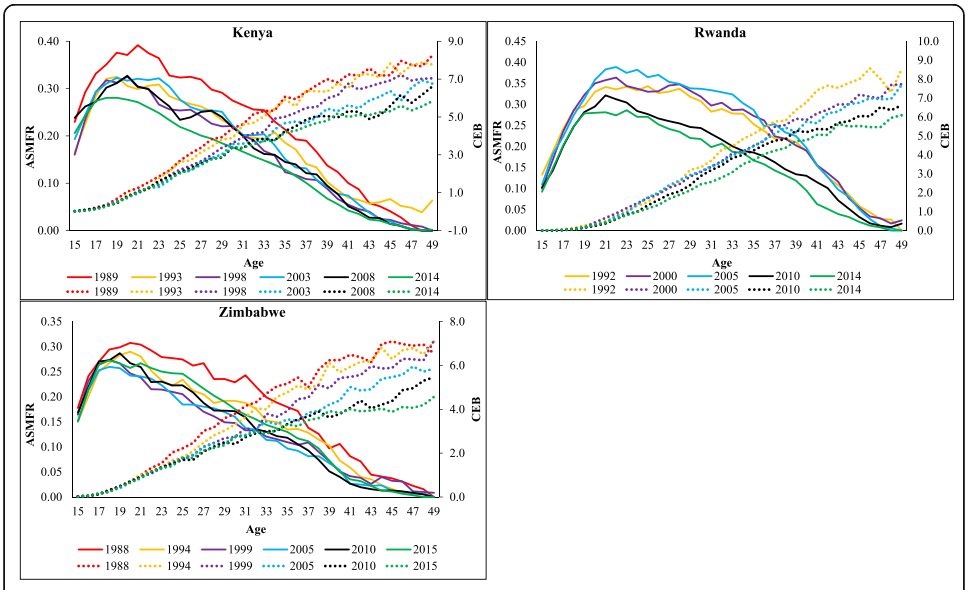

Fig. 5 Differences between ASMFRs and CEB in depicting marital fertility changes

Acknowledgements
Not applicable

Authors' contributions
The authors PN (student) and CO (supervisor) contributed to the design of the study as well as the production. As the student, PN undertook data analysis, interpretation, and writing of the manuscript with constant oversight and tutelage from CO. Both authors read and approved the final manuscript.

Funding
This research is an excerpt from a doctoral thesis held at the University of the Witwatersrand. The financial assistance of the National Institute for the Humanities and Social Sciences (NIHSS), in collaboration with the Council for the Development of Social Science Research in Africa (CODESRIA) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at are those of the author and are not necessarily to be attributed to the NIHSS and CODESRIA.

Availability of data and materials
The datasets generated and/or analysed during the current study are available in the Measure DHS repository, https://dhsprogram.com/data/.

Competing interests
The authors declare that they have no competing interests.

Received: 25 March 2019 Accepted: 30 July 2019
Published online: 16 August 2019

References

Agadjanian, V., & Yabiku, S. T. (2014). Religious affiliation and fertility in a sub-Saharan context: Dynamic and lifetime perspectives. *Popul Res Policy Rev, 33*, 673–691 https://doi.org/10.1007/s11113-013-9317-2.

Andreyeva, T., Long, M. W., & Brownell, K. D. (2010). The impact of food prices on consumption: A systematic review of research on the price elasticity of demand for food. *Am J Public Health, 100*, 216–222 https://doi.org/10.2105/AJPH.2008.151415.

Askew, I., Maggwa, N., & Obare, F. (2017). Fertility transitions in Ghana and Kenya: Trends, determinants, and implications for policy and programs. *Population and Development Review, 43*, 289–307 https://doi.org/10.1111/padr.12010.

Bakibinga, P., Mutombo, N., Mukiira, C., Kamande, E., Ezeh, A., & Muga, R. (2016). The influence of religion and ethnicity on family planning approval: A case for women in rural Western Kenya. *Journal of Religion and Health, 55*, 192–205.

Balbo, N. (2015). Fertility theory. In J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences* (2nd ed., pp. 19–27). Oxford: Elsevier.

Beguy, D., Ezeh, A. C., Mberu, B. U., & Emina, J. B. O. (2017). Changes in use of family planning among the urban poor: Evidence from Nairobi slums. *Population and Development Review, 43*, 216–234 https://doi.org/10.1111/padr.12038.

Bianchi, S. M. (2014). A demographic perspective on family change. *Journal of Family Theory, 6*, 35–44.

Billy, J. O., & Moore, D. E. (1992). A multilevel analysis of marital and nonmarital fertility in the US. *Social Forces, 70*, 977–1011.

Blacker, J. (2002). Kenya's fertility transition: How low will it go? In *Completing the Fertility Transition (ESA/P/WP. 172/Rev. 1)*. New York: United Nations.

Blanc, A. K., & Rutstein, S. O. (1994). The demographic transition in Southern Africa: Yet another look at the evidence from Botswana and Zimbabwe. *Demography, 31*, 209–215.

Bongaarts, B., & Potter, R. (1983). *Fertility, biology, and behavior: An analysis of the proximate determinants*. New York and London: Academic Press.

Bongaarts, J. (2006). The causes of stalling fertility transitions. *Studies in Family Planning, 37*, 1–16.

Bongaarts, J. (2008). Fertility transitions in developing countries: Progress or stagnation? *Studies in Family Planning, 39*, 105–110.

Bongaarts, J. (2015). Modelling the fertility impact of the proximate determinants: Time for a tune-up. *Demographic Research, 33*, 535–560.

Bongaarts, J. (2017). The effect of contraception on fertility: Is sub-Saharan Africa different? *Demographic Research, 37*, 129–146 https://doi.org/10.4054/DemRes.2017.37.6.

Bongaarts, J., & Casterline, J. (2013). Fertility transition: Is sub-Saharan Africa different? *Popul Dev Rev, 38*, 153–168 https://doi.org/10.1111/j.1728-4457.2013.00557.x.

Bongaarts, J., Frank, O., & Lesthaeghe, R. (1984). The proximate determinants of fertility in sub-Saharan Africa. *Population and Development Review*, 511–537.

Bulatao, R. A., & Casterline, J. B. (2001). Global fertility transition. *Population and Development Review* Suppliment to Vol.27.

Burger, R. P., Burger, R., & Rossouw, L. (2012). The fertility transition in South Africa: A retrospective panel data analysis. *Development Southern Africa, 29*, 738–755 https://doi.org/10.1080/0376835X.2012.731779.

Caldwell, J. C. (1977). The economic rationality of high fertility: An investigation illustrated with Nigerian survey data. *Population Studies, 31*, 5–27 https://doi.org/10.1080/00324728.1977.10412744.

Caldwell, J. C., & Caldwell, P. (1987). The cultural context of high fertility in sub-Saharan Africa. *Population and Development Review, 13*, 409–437 https://doi.org/10.2307/1973133.

Caldwell, J. C., & Caldwell, P. (2002). *Fertility transition in Sub-Saharan Africa. Presented at the Fertility and the current South African issues of poverty*. Pretoria: HIV/AIDS and youth.

Casterline, J. (1981). Community effects on individual demographic behavior: Multilevel analysis of WFS data. In *International Population Conference, Manila 1981: proceedings and selected papers. Vol. 5* (pp. 405–421).

Casterline, J., & El-Zeini, L. (2017). Unmet need and fertility decline: A comparative perspective on prospects in sub-Saharan Africa. *Studies in Family Planning, 45*, 227–245.
Casterline, J. B. (2001). Diffusion processes and fertility transition: Introduction. In J. B. Casterline (Ed.), *Diffusion processes and fertility transition: Selected perspectives, Committee on Population, Division of Behavioral and Social Sciences and Education, National Research Council*. Washington DC: National Academies Press (US).
Colleran, H., Jasienska, G., Nenko, I., Galbarczyk, A., & Mace, R. (2014). Community-level education accelerates the cultural evolution of fertility decline. *Proc Biol Sci*, 281 https://doi.org/10.1098/rspb.2013.2732.
DeCicca, P., & Kenkel, D. (2015). Synthesizing econometric evidence: The case of demand elasticity estimates. *Risk Analysis, 35*, 1073–1085.
Dodoo, F. N.-A. (1993). A couple analysis of micro-level supply/demand factors in fertility regulation. *Popul Res Policy Rev, 12*, 93–101 https://doi.org/10.1007/BF01074559.
Dodoo, F. N.-A. (1995). Explaining contraceptive use differences: Do men play a role? *African Population Studies, 10* https://doi.org/10.11564/10-1-402.
Dodoo, F. N.-A. (1998). Men matter: Additive and interactive gendered preferences and reproductive behavior in Kenya. *Demography, 35*, 229–242 https://doi.org/10.2307/3004054.
Dodoo, F. N.-A., Luo, Y., & Panayotova, E. (1997). Do male reproductive preferences really point to a need to refocus fertility policy? *Population Research and Policy Review, 16*, 447–455 https://doi.org/10.1023/A:1005762323535.
Dodoo, F. N.-A., & van Landewijk, P. (1996). Men, women, and the fertility question in sub-Saharan Africa: An example from Ghana. *African Studies Review, 39*, 29–41 https://doi.org/10.2307/524942.
Ezeh, A. (1991). *Gender differences in reproductive orientation in Ghana: A new approach to understanding fertility and family planning issues in sub-Saharan Africa*. Washington DC: Presented at the Demographic and Health Surveys World Conference.
Ezeh, A. C., & Dodoo, F. N.-A. (2001). Institutional change and the African fertility transition: The case of Kenya. *Genus, 57*, 135–164.
Ezeh, A. C. (1992). *Contraceptive practice in Ghana: Does partner's attitude matter? Presented at the Population Association of America*. Colorado: Denver.
Fortin, N., Lemieux, T., & Firpo, S. (2011). Chapter 1 - Decomposition methods in economics. In O. Ashenfelter & D. Card (Eds.), *Handbook of labor economics* (pp. 1–102). Elsevier https://doi.org/10.1016/S0169-7218(11)00407-2.
Garenne, M. (2004). Age at marriage and modernisation in sub-Saharan Africa. *Southern African Journal of Demography, 9*, 59–79.
Garenne, M. (2008). *Overview on fertility changes in sub-Saharan Africa (No. 17), DHS Comparative Reports*. Calverton MD: ORC Macro.
Garenne, M. (2012). *Education and fertility in sub-Saharan Africa: A longitudinal perspective (No. 33), DHS Analytical Studies*. Calverton: ICF International.
Garenne, M., & Joseph, V. (2002). The timing of the fertility transition in sub-Saharan Africa. *World Development, 30*, 1835–1843 https://doi.org/10.1016/S0305-750X(02)00069-4.
Garenne, M. L. (2011). Testing for fertility stalls in demographic and health surveys. *Population health metrics, 1*, 18.
Gries, T., & Grundmann, R. (2015). Fertility and modernization: The role of urbanization in developing countries. *Journal of International Development, 30*, 493–506.
Handwerker, W. P. (1991). Women's power and fertility transition: The cases of Africa and the West Indies. *Population and Environment, 13*, 55–78.
Hartmann, M., Gilles, K., Shattuck, D., Kerner, B., & Guest, G. (2012). Changes in couples' communication as a result of a male-involvement family planning intervention. *Journal of Health Communication, 17*, 802–819 https://doi.org/10.1080/10810730.2011.650825.
Hertrich, V. (2017). Trends in age at marriage and the onset of fertility transition in sub-Saharan Africa. *Population and Development Review, 43*, 112–137 https://doi.org/10.1111/padr.12043.
Houle, B., Pantazis, A., Kabudula, C., Tollman, S., & Clark, S. J. (2016). Social patterns and differentials in the fertility transition in the context of HIV/AIDS: Evidence from population surveillance, rural South Africa, 1993–2013. *Popul Health Metr, 14* https://doi.org/10.1186/s12963-016-0079-z.
Indongo, N., & Pazvakawambwa, L. (2012). Determinants of fertility in Namibia: Original research article. *African journal of reproductive health, 16*, 50–57.
Jann, B., & Zurich, E. (2008). The Blinder-Oaxaca decomposition for linear regression models. *The Stata Journal, 8*, 453–479.
Kimuna, S. R., & Adamchak, D. J. (2001). Gender relations: Husband–wife fertility and family planning decisions in Kenya. *Journal of Biosocial Science, 33*, 13–23 https://doi.org/10.1017/S002193200100013X.
Kravdal, Ø. (2002). Education and fertility in Sub-Saharan Africa: Individual and community effects. *Demography, 39*, 233–250 https://doi.org/10.2307/3088337.
Kravdal, Ø. (2012). Further evidence of community education effects on fertility in sub-Saharan Africa. *Demographic Research, 27*, 645–680 https://doi.org/10.4054/DemRes.2012.27.22.
Letamo, G., & Letamo, H. N. (2001). The role of proximate determinants in fertility transition: A comparative study of Botswana, Zambia and Zimbabwe. *Southern African Journal of Demography*, 29–35.
Love, A. E. H. (2013). *A treatise on the mathematical theory of elasticity*. Cambridge University Press.
Mbacké, C. (1994). Family planning programs and fertility transition in sub-Saharan Africa. *Population & Development Review, 20*, 188–193.
Mbacké, C. (2017). The persistence of high fertility in sub-Saharan Africa: A comment. *Population and Development Review, 43*, 330–337 https://doi.org/10.1111/padr.12052.
Mbizvo, M. T., & Adamchak, D. J. (1991). Family planning knowledge, attitudes, and practices of men in Zimbabwe. *Studies in Family Planning, 22*, 31–38.
McNay, K., Arokiasamy, P., & Cassen, R. (2003). Why are uneducated women in India using contraception? A multilevel analysis. *Population Studies, 57*, 21–40.
Mensch, B. S., Grant, M., & Blank, A. (2006). The changing context of sexual initiation in sub-Saharan Africa. *Population and Development Review, 32*, 699–727.
Moultrie, T. A., Hosegood, V., McGrath, N., Hill, C., Herbst, K., & Newell, M.-L. (2008). Refining the criteria for stalled fertility declines: An application to rural KwaZulu-Natal, South Africa, 1990-2005. *Studies in Family Planning, 39*, 39–48.
Mturi, A., & Joshua, K. (2011). Falling fertility and increase in use of contraception in Zimbabwe. *African Journal of Reproductive Health, 15*.
Murthi, M. (2002). Fertility change in Asia and Africa. *World Development, 30*, 1769–1778 https://doi.org/10.1016/S0305-750X(02)00062-1.

Ndagurwa, P., & Odimegwu, C. (2019). Decomposition of Zimbabwe's stalled fertility change: A two-sex approach to estimating education and employment effects. *J Pop Research, 36*, 35–63 https://doi.org/10.1007/s12546-019-09219-8.
Ngome, E., & Odimegwu, C. (2014). The social context of adolescent women's use of modern contraceptives in Zimbabwe: A multilevel analysis. *Reproductive Health, 11*, 64 https://doi.org/10.1186/1742-4755-11-64.
Odimegwu, C., Bamiwuye, O. S., & Adedini, S. A. (2015). Gender-based violence as a new proximate determinant of fertility in sub-Saharan Africa. *Southern African Journal of Demography, 16*, 87.
Ortega, O. J. A. (2014). A characterisation of world union patterns at the national and regional level. *Population Research and Policy Review, 33*, 161–188.
Palamuleni, M. E. (2017). Determinants of fertility decline in Namibia: An analysis of the proximate determinants. *Bangladesh e-Journal of Sociology, 14*, 41–63.
Parr, N. (2002). Family planning promotion, contraceptive use and fertility decline in Ghana. *African Population Studies, 17*, 1–26.
Parr, N. J. (1992). *An analysis of fertility differentials in Lybia and Ghana using multilevel models (PhD)*. University of Southampton, School of Social Sciences, Department of Social Statistics, England.
Schoumaker, B. (2013). A Stata module for computing fertility rates and TFRs from birth histories: tfr2. *Demographic Research, 28*, 1093–1144 https://doi.org/10.4054/DemRes.2013.28.38.
Schoumaker, B., & Hayford, S. R. (2004). A person-period approach to analysing birth histories. *Population (English Edition, 2002-), 59*, 689–701.
Sen, B. (2014). Using the Oaxaca–Blinder decomposition as an empirical tool to analyze racial disparities in obesity. *Obesity, 22*, 1750–1755 https://doi.org/10.1002/oby.20755.
Shapiro, D. (2013). Stalling of fertility transitions and socioeconomic change in the developing world: Evidence from the demographic and health surveys. *Ralentissements, résistances et ruptures dans les transitions démographiques: Actes de la Chaire Quetelet 2010, 47*.
Shapiro, D., & Gebreselassie, T. (2009). *Fertility transition in sub-Saharan Africa: Falling and stalling African Population Studies* (p. 23).
Shapiro, D., & Gebreselassie, T. (2014). Marriage in sub-Saharan Africa: Trends, determinants and consequences. *Population Research and Policy Review, 33*, 229–255.
Shapiro, D., & Tambashe, B. O. (2002). Fertility transition in urban and rural sub-Saharan Africa: Preliminary evidence of a three-stage process. *Journal of African Policy Studies, 8*, 105–130.
Shapiro, D., & Tenikue, M. (2015). *Women's education, infant and child mortality, and fertility decline in sub-Saharan Africa: A quantitative assessment*. Luxembourg Institute of Socio-Economic Research (LISER) Working Paper Series 7.
Siah, A. K. L., & Lee, G. H. Y. (2015). Female labour force participation, infant mortality and fertility in Malaysia. *Journal of the Asia Pacific Economy, 0*, 1–17 https://doi.org/10.1080/13547860.2015.1045326.
Tabutin, D., Schoumaker, B., & Rabenoro, M. (2004). The demography of sub-Saharan Africa from the 1950s to the 2000s. *Population, 59*, 455–555.
Udjo, E. O. (1996). Is fertility falling in Zimbabwe. *Journal of Biosocial Science, 28*, 25–35.

Publisher's Note