# The fertility revolution in Zimbabwe with special regards to proximate determinants of fertility

Collet Muza*

Charles University, Faculty of Science, Department of Demography and Geodemography, Prague, Czechia
* Corresponding author: colletmuza@gmail.com

**ABSTRACT**

The role of proximate determinants in moderating fertility decline is well documented in developing countries. In Zimbabwe, however, there is a limited understanding of the role of proximate determinants on fertility levels and trends. This study aimed to examine the role of proximate determinants of fertility (namely marriages, postpartum infecundity and contraception) using the Bongaarts proximate determinants model. The impact of these determinants is studied on a sample of married women aged 15–49 years' and corresponding cross-sectional data obtained through the six consecutive Zimbabwe Demographic Health Surveys (ZDHSs) hold in 1988, 1994, 1999, 2005 and 2015. The results reveal that the overall fertility declined from 5.4, 3.8 and 4.0 children per woman observed among 1988, 1999 and 2015 ZDHSs, respectively. This change was caused by the contraceptive inhibitive effect, which correspondingly increased from 3.00 to 4.65 and 6.45 children per woman. The fertility stalling observed in 1999 and after that is caused by postpartum infecundity and marital fertility inhibition which decreased with time. Moreover, contraceptive inhibition effect increased with education, wealth quintiles, and urban residence. In contrast, marital and postpartum infecundity fertility inhibition effects inversely correlate with education, wealth quintiles, and the place of residence. Therefore, to foster further fertility decline to replacement level, policies should promote contraceptive adoption, more extended breastfeeding periods and delay entry into early marriages. Furthermore, women empowerment, especially the promotion of female education to higher education and female employment, could be useful tools to further fertility decline.

**KEYWORDS**

proximate determinants; fertility stalling; decomposition; Bongaarts model

Received: 18 April 2019
Accepted: 25 September 2019
Published online: 9 December 2019

Muza, C. (2019): The fertility revolution in Zimbabwe with special regards to proximate determinants of fertility.
AUC Geographica 54(2), 182–193
https://doi.org/10.14712/23361980.2019.16

## 1. Introduction

A significant number of African countries have experienced either sustained high fertility or fertility stalling at midway transition, which has put future prospects of fertility decline into doubt and made demographers question the demographic transition theory. According to Bongaarts (2008), fertility stalling is when a country does not experience significant fertility decline of 10% or more between two successive surveys demographic and health surveys. Consequently, because of sustained high fertility and low mortality, the population growth rate in Africa has remained high at about 2.5% per annum since 1960 (United Nations 2017). The population doubling time associated with such an annual growth rate is 28 years. Thus, the population of Africa grew from 0.3 to 1.2 billion from 1960 to 2015 (ibid.). The challenge is that high population growth has been shown to negatively affect socio-economic and human development (Birdsall and Sinding 2001). This is alarming since Africa is already the world's least developed region (United Nations 2017).

In 1956, it was propounded that socioeconomic background factors operate through 11 proximate determinants to influence the level of fertility in any society (Davis and Blake 1956). Further, Bongaarts (1978) revised and reduced Davies and Blake's 11 into 7 proximate determinants of fertility. Furthermore, Bongaarts (1982) demonstrated, that 96% of fertility levels and variation in developing countries is a result of four main proximate determinants; marriage, postpartum infecundity, abortion and contraception. The remaining seven variables explain a small part of the total fertility rate variation (ibid.). The challenge is that Africa lacks historical and current complete vital registration systems for conducting such analysis (Dyson 2013). However, the seminal work of Notestein (1945) has established that the fertility revolution from natural to controlled fertility regimes is a result of the deliberate adoption of birth control methods (contraception). Unlike Europe where women of older reproductive ages used stopping reproductive behaviour and natural methods of fertility limitation, in Africa, efficient modern methods of contraception were used for both child spacing and stopping in younger and older reproductive ages respectively (Caldwell and Caldwell 2002). Thus, in Africa, the fertility revolution, although still incomplete, once started, is more rapid than Europe's historical fertility transitions.

In Zimbabwe, fertility had declined from *TFR* 5.4 in 1984 to 3.8 in 1999 has been both development and crisis-driven fertility decline (Mhloyi 1988; Müller et al. 2013). Development-driven fertility decline is typical of the Becker's theory of fertility decline when for instance, highly urbanized, educated and high incomes women were further ahead in the fertility transition than disadvantaged socioeconomic groups (Mhloyi 1988; Müller et al. 2013). In contrast, crisis-driven fertility decline is when a combination of high costs of living, declining incomes, civil unrest and persistence droughts in Zimbabwe has forced couples, regardless of their levels of modernization, to adopt their fertility downwards (Mhloyi 1988). For instance, the costs related to the education of the children rather than the education of mothers themselves have led women to decrease their demand for children. In other words, the high costs of living reverse the wealth flow from children to parents (Caldwell and Caldwell 2002).

However, Gould (2015) has argued that crisis-driven fertility decline cannot be sustained in the long run. Precisely fertility in Zimbabwe has stalled at midway transition at about 4 children per woman since 2000 (ZIMSTAT and ICF International 2016). The question is whether fertility stalled as a result of changes in background variables or changes in proximate determinants?

Although the effects of the proximate determinants on fertility have been documented in Zimbabwe (Guilkey and Jayne 1997; Letamo and Letamo 2001; Mhloyi 1986; Muhwava and Muvandi 1994; Sibanda 1999), little has been done recently to show the current scenario with regard to proximate determinants. Undoubtedly, the socioeconomic circumstances appear to have changed since significantly changed, which might also change the proximate determinants. Thus, this study seeks to assess the proximate determinants of fertility in Zimbabwe, incorporating recent data. The data were pooled from 6 consecutive (1988, 1994, 1999, 2005 2010, and 2015) Zimbabwe Demographic and Health Surveys (ZDHSs). This study will contribute to our knowledge and understanding of proximate determinants of fertility in Zimbabwe and how they have associated fertility levels and trends.

A substantial body of literature has generally agreed that Africa's early and universal nuptiality conditions are more conducive to high fertility rates than witnessed in Europe's historical conditions (Chesnais 1992; Coale 1973; Dyson 2013). Undeniably, entry into marriage serves as a risk factor to childbearing as most of the childbearing was happening in marriages (Bongaarts 1982; Coale 1973). In Zimbabwe, a recent study by Sayi and Sibanda (2018) based on 2014 Zimbabwe Multiple Indicators Cluster Survey (MICS) indicates that 1 in 4 women aged 15–19 years were currently married, while among 20–49 years about 32% were married before 18 years of age. Further, the gap between marriage and childbearing is very small as couples seek to strengthen their marriage with children (Chitereka and Nduna 2010). Marital dissolutions have been found to be insignificant to fertility levels as remarriages occur early (Mhloyi 1988). However, it is possible that nuptiality patterns changed with time and consequently fertility levels.

Polygyny is generally high and variable in Africa. McDonald (1985) reported that polygyny ranged from 10% to 67% in Lesotho and Senegal, respectively. In

Zimbabwe in a recent survey, polygamous unions have been found to be 8% and 16% in urban and rural areas, respectively (ZIMSTAT and ICF International 2016). Studies on the effects of polygamy on fertility offer contradictory evidence. On the one hand, since women in the polygamous union share time of husband, they have less exposure to sex than women in monogamous relationships and correspondingly have less risky to pregnancy. Moreover, women in polygamous unions have been noted to breastfeed longer than women in monogamous unions (Sayi and Sibanda 2018; Mhloyi 1988). On the other hand, Mhloyi (ibid.) argued that women in polygamous unions' demand for children is higher than women in monogamous unions, as more children offer them security, respect and access to husband's wealth. The question is, has the polygyny patterns changed with inevitable modernization?

Furthermore, although variable and decreasing with modernization, Africa's long postpartum abstinences were strategies ensuring the survival of already born children through prolonged birth spacing rather than deliberate birth control methods (ibid.). Caldwell and Caldwell (2002) have argued that child spacing is embedded in the African culture, and high levels of contraceptive use might be for spacing and not stopping childbearing. Nonetheless, it can be hypothesised that postpartum infecundity has decreased with modernization. In the absence of alternative contraceptive adoption or increments, fertility can increase.

Several studies have employed the Bongaarts framework for the analysis of the fertility differentials, levels and transitions in Africa (Chola and Michelo 2016; Majumder and Ram 2015; Rutaremwa et al. 2015; Mturi and Kembo 2011; Sibanda 1999; Bongaarts 1978). A recent analysis of countries in the early stages of fertility transition namely Namibia (Palamuleni 2017); Zambia (Chola and Michelo 2016), Uganda (Rutaremwa et al. 2015), Malawi (Palamuleni 1996), and found the dual importance of marriage and postpartum infecundability as most important predictors of fertility outcomes. The contribution of contraception was least although it was increasing rapidly.

In African countries that have experienced significant fertility decline, it has been established that the contribution of contraception is the most important and amenable to fertility reduction (Finlay, Mejia-Guevara and Akachi 2018; Majunder and Ram 2015; Mturi and Kembo 2011; Sibanda 1999). Sibanda (1999) looking at the relative contribution of proximate determinants in Zimbabwe and Kenya using two consecutive surveys for each country show that in Zimbabwe contraception is the most important factor in fertility decline in younger and middle ages. In Kenya, with slightly higher fertility than Zimbabwe, it was found that postpartum infecundity was the most important factor followed by marriage. In a later study using 2005/06 DHS data on Zimbabwe Mturi and Kembo (2011) reveal that high contraception prevalence rate was the most important factor of fertility decline even during periods of socioeconomic development and socioeconomic crisis. The question is why fertility in Zimbabwe has stalled at midway transition given such high contraceptive prevalence rate? South Africa (*TFR* 2.3) and Botswana (*TFR* 2.6) with similar contraceptive prevalence levels and they have lower fertility approaching replacement level fertility (United Nations 2017). This is important given that studies have revealed contraception prevalence of 75% is associated with replacement level fertility (Mahjabeen and Khan 2011).

It is also possible that contraceptives such as condoms might be used for HIV prevention but not parity-specific fertility limitation behaviour (Terceira et al. 2003). Nonetheless, studies have revealed the contributory effects of the proximate determinants vary positively with women empowerment, i.e. women's education, wealth quintiles, urban and rural residence. In Zambia, secondary education and urban residence and wealth were established to be positively related to higher relative fertility inhibition effect in marriage and contraception whilst postpartum infecundability was inversely correlated (Chola and Michelo 2016). Similar findings were made in Uganda (Rutaremwa et al. 2015) and in Zimbabwe (Mturi and Kembo 2011; Sibanda 1999).

## 2. Data and methods

### 2.1 Sources of data

This paper utilizes pooled data from 6 consecutive ZDHSs conducted in 1988, 1994, 1999, 2005, 2010 and 2015. In each survey year, a nationally representative survey of ever-married women of age 15–49 which were conducted under the collaboration of Zimbabwe National Statistics Agency (ZIMSTAT) and ICF International. The ZDHSs provides nationally representative data on basic health social and demographic indicators. The study utilized this data in order to fit the aggregate fertility model, thereby assessing the contribution of marriage, contraception and postpartum infecundability in Zimbabwe. The fertility estimates were also disaggregated by a number of selected socioeconomic variables, namely residence, education and wealth quintiles.

### 2.2 Sampling

The sample sizes of the interviewed women age (15–49) were selected based on a master sampling plan which was provided by ZIMSTAT (1988–2015). Sampling was done using a two-stage cluster sampling process. Initially, clusters are selected from a list of clusters obtained from the master sampling plan provided by ZIMSTAT, followed by a section of households from each cluster. The data obtained were stratified by rural and urban areas. The samples are considered adequate to enable analysis and comparisons that would be useful in the identification of socioeconomic and demographic locus that could guide fertility and population policy interventions in Zimbabwe.

### 2.3 Analytical framework

Bongaarts' proximate determinants model (1978, 1982) was applied for analyzing proximate determinants of fertility from the six successive ZDHSs named above. Bongaarts and Potter (1983) developed a technique to quantify the impact of four proximate determinants on fertility, namely marriage, contraception, abortion, and postpartum infecundability. They assume that the total fecundity rate (TF) of all women is the same, but their real reproductive performance is modified by the above four mentioned proximate determinants. The mechanism of the model is summarized by relating the fertility measures to the proximate determinants. The basic model equations are:

(a) $TFR = C_m \times C_i \times C_c \times C_a \times TF$ (Bongaarts 1982),
(b) $TM = C_i \times C_c \times C_a \times TF$ (Chola and Michelo 2016),
(c) $TN = C_i \times TF$ (ibid.),

where *TFR* is the number of births, a woman would have at the end of her reproductive years if she were to bear children at the prevailing age-specific fertility rates throughout the reproductive period. Total marital fertility rate (*TM*) is the number of births a woman would have at the end of her reproductive year if she were to bear children at the prevailing age-specific marital fertility rates and remain married during the entire reproductive period (Bongaarts 1987). Total natural fertility rate (*TN*) is observed under conditions in which contraception and abortions are eliminated (Bongaarts 1982). Bongaarts noted that whilst *TFR*, *TM*, and *TN* vary in many populations, total fecundity is constant in all populations. Total natural fecundity rate (*TF*) index is estimated as follows:

$TF = TFR / (C_m \times C_i \times C_c \times C_a)$ (Bongaarts 1982),

where, $C_m$, $C_i$, $C_c$, and $C_a$ are indices of marriage, postpartum infecundability, and contraception and induced abortion, respectively. The indices can only take values between 0 and 1. Where there is no fertility inhibiting effect of a given intermediate fertility variable, the corresponding index equals one, and when the fertility inhibition is complete the index equal 0 (Bongaarts 1982). Abortion is illegal in Zimbabwe (ZIMSTAT and ICF International 2016; Sibanda 1999), and there is limited and unreliable information. Therefore, the index of abortion in this study will be 1. The contribution of abortion is regarded as insignificant. The indices can be approximated from the measure of proximate variables.

### 2.4 Index of marriage ($C_m$)

The index of marriage ($C_m$) measures the inhibiting effects of marriage on fertility in the population. The lower the proportions of married, the higher the inhibiting effects of marriage and the inverse is true. However, age-specific marital proportions are used since inhibiting effects of marriage are marital age distribution sensitive. Childbearing is greatest in the central age distribution years. Marriage is defined as formal or consensus marriages. Implicit in this definition is the assumption that only women in marriages are exposed to the risk of childbearing. The ZDHSs done in 1999, 2005, 2010 and 2015 has classified cohabitation as a marital union in Zimbabwe. This was not the case in 1988 and 1994 since no information was collected on this variable. In order to make the ZDHSs marital definition comparable, we take the earlier definition used in 1988 and 1994. The index is estimated as follows:

$$C_m = \frac{\sum m(a)g(a)}{\sum g(a)} \quad \text{(Bongaarts 1982)},$$

where $m(a)$ is age-specific proportions currently married women. This characteristic is computed by dividing the number of married women by the total number of women in the same age group. Also, $g(a)$ is age-specific marital fertility rates. It is computed by dividing the births of a particular age group (from married women) by the number of married women in the same age group.

### 2.5 Index of contraception ($C_c$)

The index of contraception measure the inhibiting effects of modern methods of contraception on fertility in a population which also varies with the prevalence and use-effectiveness of contraception used by couples in the reproductive age groups. The higher the level of contraception in a population, the higher the inhibiting effect of contraception and vice versa. The index of contraception is estimated using the following:

$C_c = 1 - 1.08 \times u \times e$ (Bongaarts and Potter 1983),

where $u$ is the average proportion of married women currently using contraception;  is average contraceptive effectiveness. The coefficient 1.08 is the sterility correction factor (represents the adjustment for the fact that women do not use contraception if they know they are sterile). The parameter $e$ values proposed for particular contraceptives are as follows: pill 0.90, IUD 0.95, injection 0.99, sterilization 1.00, others 0.70 (Bongaarts and Potter 1983).

### 2.6 Index of postpartum infecundability ($C_i$)

The index of postpartum infecundability is a measure of the inhibiting effect of breastfeeding or sexual abstinence on fertility in a population (Bongaarts

1982). The index of postpartum infecundability in the model is estimated using the effect of breastfeeding (lactation amenorrhea) or postpartum abstinence. The index was calculated as follows:

$C_1 = 20/18.5 + i$ (Bongaarts 1982),

where the symbol $i$ represents the average duration in months of infecundability from birth to the first postpartum ovulation (menses), in this research, the index of postpartum infecundability was estimated using the mean duration of breastfeeding.

## 2.7 Index of abortion ($C_a$)

The index of abortion measures the inhibiting effect of abortion on fertility in a population. In this research, the index of abortion was set 1.0 due to lack of data. Abortion is illegal in Zimbabwe excerpt for health and legal reasons (ZIMSTAT and ICF International 2016). Moreover, abortion data in the ZDHSs include stillbirths and miscarriages. Therefore, it is difficult to isolate abortion data. The index of abortion is estimated using the following formula:

$C_a = TFR/TFR + b \times TA = TFR/TFR + 0.4 \times (1 + U) \times TA$ (Bongaarts and Potter 1983)

where $U$ is contraceptive prevalence use, $b$ is the average number of births averted per induced abortion and $b = 0.4(1 + U)$; $b$ is 0.4 when $U = 0$ and $b = 0.8$ when $U = 1.0$. $TA$ is total abortion (an average number of induced abortion per woman at the end of the reproductive period if induced abortions remain at prevailing levels throughout the reproductive period). Then $C_a = 1.0$ if $TA = 0$. Therefore, the index of abortion in this study is equal to .

Based on the studies of historical populations with the highest recorded fertility, Bongaarts recommends

Tab. 1 Percentage distribution of respondent women, 15–49 years by selected characteristics (weighted), 1988–2015, Zimbabwe.

| | | 1988 | 1994 | 1999 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|---|---|
| Children born | 1–3 | 34.9% | 38.1% | 44.7% | 47.6% | 52.3% | 50.2% |
| | 4–5 | 16.7% | 15.0% | 12.9% | 14.0% | 14.6% | 17.0% |
| | 6+ | 19.9% | 17.5% | 12.6% | 9.0% | 6.7% | 6.1% |
| Marital status | Never married | 27.0% | 26.9% | 27.7% | 27.0% | 24.0% | 25.2% |
| | Married | 62.9% | 61.8% | 56.3% | 56.3% | 59.4% | 58.7% |
| | Divorced | 7.6% | 7.8% | 3.5% | 4.5% | 3.7% | 5.0% |
| | Widowed | 2.5% | 3.5% | 4.2% | 7.5% | 6.1% | 4.4% |
| Age group | 15–19 | 24.3% | 24.0% | 24.5% | 24.2% | 21.2% | 22.1% |
| | 20–24 | 20.0% | 20.7% | 21.9% | 21.9% | 20.1% | 17.0% |
| | 25–29 | 16.2% | 14.9% | 17.5% | 16.5% | 18.4% | 16.6% |
| | 30–34 | 14.0% | 14.2% | 11.3% | 13.7% | 14.1% | 16.3% |
| | 35–39 | 11.0% | 10.8% | 10.8% | 9.4% | 11.5% | 12.4% |
| | 40–44 | 7.6% | 8.7% | 7.9% | 7.8% | 8.0% | 9.7% |
| | 45–49 | 6.9% | 6.6% | 6.1% | 6.6% | 6.8% | 5.8% |
| Residence | Urban | 33.5% | 32.2% | 38.6% | 39.3% | 38.7% | 38.5% |
| | Rural | 66.5% | 67.8% | 61.4% | 60.7% | 61.3% | 61.5% |
| Education | No education | 13.5% | 11.1% | 6.7% | 4.3% | 2.3% | 1.35 |
| | Primary | 55.9% | 47.3% | 40.2% | 32.6% | 28.0% | 25.8% |
| | Secondary | 29.7% | 40.0% | 50.2% | 60.15 | 65.1% | 65.6% |
| | Higher | 0.9% | 1.6% | 2.8% | 3.0% | 4.6% | 7.3% |
| Wealth quintile | Poorest | – | 18.2% | 17.1% | 17.4% | 16.9% | 17.1% |
| | Poorer | – | 16.1% | 17.3% | 16.8% | 17.4% | 17.0% |
| | Middle | – | 18.9% | 18.4% | 17.4% | 18.3% | 17.6% |
| | Richer | – | 21.8% | 22.3% | 22.5% | 22.6% | 23.2% |
| | Richest | | 25.0% | 24.9% | 25.9% | 24.8% | 25.1% |
| Family Planning (married) | Modern (any) | 36.1% | 42.2% | 50.4% | 58.4% | 57.3% | 65.8% |
| | Traditional | 7.0% | 4.3% | 2.8% | 1.4% | 1.1% | 1.0% |
| Mean duration of breastfeeding | Months | 18.9 | 18.8 | 19.0 | 18.7 | 17.5 | 18.1 |
| Total (n) | | 4,201 | 6,128 | 5,907 | 8,907 | 9,171 | 9,955 |

– missing values
Source: ZDHSs

using 15.3 as the maximum number of births per woman. This is referred to as the Total fecundity rate (*TF*) (Bongaarts 1978; 1982). The value is the theoretical number that a woman would have if she were to continuously married from age 15–44, did not use contraceptives and did not abort any pregnancies. Multiplying all the indices together by the total fecundity rate of 15.3 produces the predicted *TFR* for the population. The predicted *TFR* will normally differ from the observed *TFR* because of underreporting of births; misreporting of behaviours measured by the indices or omission of proximate factors that help determine fertility levels in the population under study. The Bongaart's model was also applied for calculation of the proximate determinants for selected background characteristics as the place of residence, education and wealth quintiles.

## 3. Results

The individual characteristics of the respondents for six successive ZDHSs conducted between 1988-2015 are shown in table 1. The results show that the percentages living in rural areas decreased from 67% in 1988 to 61% by 2015. The results reveal that women with no education and primary education were reduced from 14% to 1% and 56% to 26% while women with secondary education simultaneously increased from 30% to 66% between 1988 and 2015 respectively. The percentage of women with higher education is still very low, although it increased from 1% to 7% from 1988 to 2015 respectively. The distribution of the respondents by age groups clearly demonstrate that percentage distribution diminished with an increase in age for the respective periods. The 1988 ZDHS did not collect data on wealth quintiles. Nonetheless, for the later ZDHSs periods with available data, the wealth quintiles stayed relatively the same with respondents in the lowest wealth quintile slightly decreasing from 18% to 17% and a simultaneous increase in the fourth wealth quintile from 22 to 23% in 1988 and 2015 respectively.

Table 1 also shows the distribution of the study by selected key proximate determinants of fertility. The percentage currently married and single declined from 63%, 56%, 59% and 27%, 24%, 25% in 1988, 1999 and 2015 respectively. The currently married percentages were considered as proportion currently married in computing the indices for marriage. Mean duration of breastfeeding from ZDHSs reports was, on average 18.5 months from 1988 to 2015, respectively, and this is what was used in the calculations to represent the average duration of the postpartum infecundability. With regard to contraception, there has been an increase in modern contraception use by married women from 36% in 1988 to 66% by 2015 and a simultaneous decrease in traditional methods from 7% to 1% from 1988 to 2015 respectively. The above-mentioned information was used in the calculation of fecundity. As highlighted in the equation above, the observed fertility levels in a population are a product of the relationship of proximate determinants and the maximum biological level of fertility.

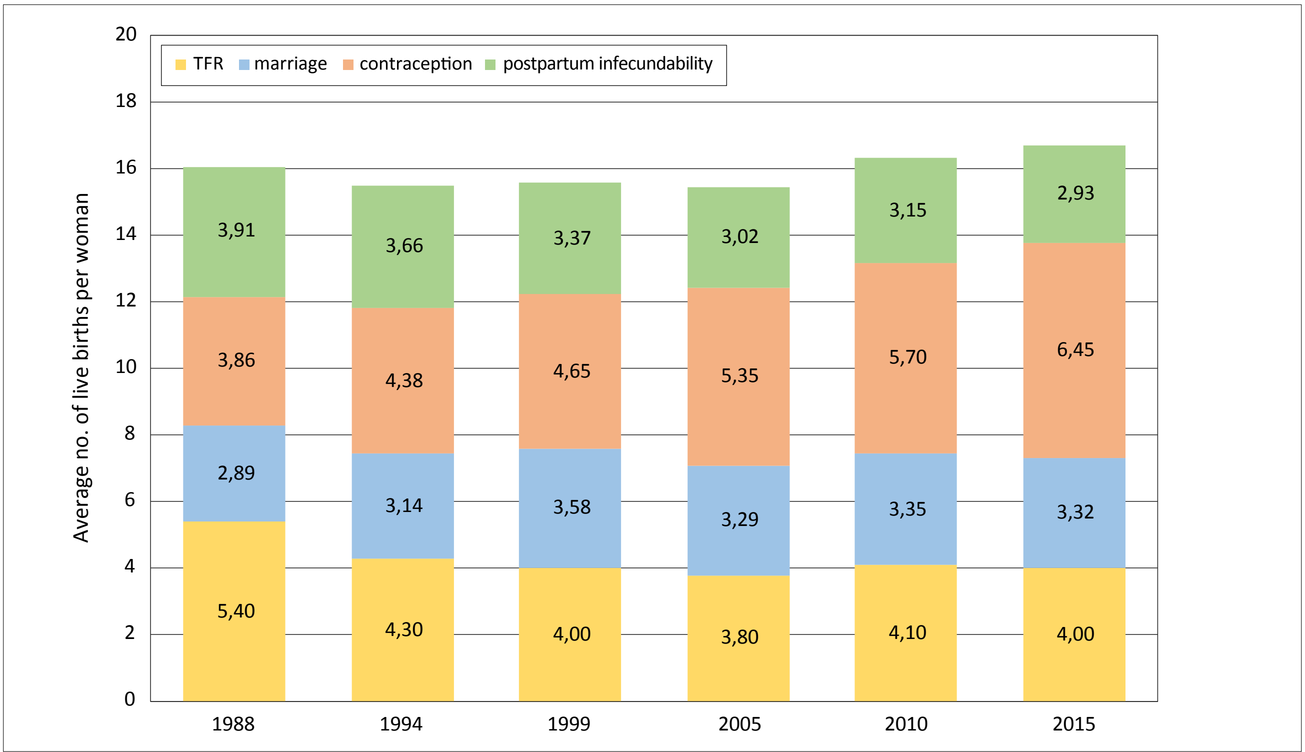


Fig. 1 Effects of proximate determinants on the total fertility rate.

Tab. 2 Estimated proximate determinants and their effect on fertility reduction, 1988–2015, Zimbabwe.

| Proximate determinant index | 1988 | 1994 | 1999 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|---|
| | Proximate determinants indices | | | | | |
| Index of marriage ($C_m$) | 0.72 | 0.69 | 0.61 | 0.62 | 0.65 | 0.63 |
| Index of contraception ($C_c$) | 0.65 | 0.60 | 0.53 | 0.46 | 0.47 | 0.41 |
| Index of postpartum infecundability ($C_i$) | 0.65 | 0.65 | 0.63 | 0.65 | 0.66 | 0.66 |
| Index of abortion ($C_a$) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | Impact on fertility reduction percentage | | | | | |
| Index of marriage ($C_m$) | 18.9% | 20.6% | 23.4% | 21.5% | 21.9% | 21.7% |
| Index of contraception ($C_c$) | 25.2% | 28.6% | 30.4% | 35.0% | 37.3% | 42.2% |
| Index of postpartum infecundability ($C_i$) | 25.5% | 23.9% | 22.0% | 19.7% | 20.6% | 19.2% |
| Index of abortion ($C_a$) | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| *TFR* predicted | 4.64 | 4.12 | 3.14 | 2.82 | 3.10 | 2.60 |
| *TFR* observed | 5.40 | 4.30 | 4.00 | 3.80 | 4.10 | 4.00 |

Source: ZDHSs and own calculations

The fecundity rate has been observed to vary from 13–17 per woman, with an average of 15.3 births per woman.

Figure 1, reveals the effect of each proximate determinant in absolute terms towards fertility reduction from the biological maximum of 15.3 children per woman, for 6 ZDHSs from 1988 to 2015. In 1988, the biggest fertility inhibition (*TFR*) was caused by postpartum infecundity ($C_i$) 3.91, followed by contraception ($C_c$) 3.86 and marriage ($C_m$) 2.89 children per woman. The contraception fertility inhibition effect continuously increased to 6.45 children per woman by 2015, whilst marriage fertility inhibition increased to a peak of 3.58 in 1999 before decreasing to 3.32 children per woman in 2015. The postpartum infecundability fertility inhibition effect has decreased to 2.93 children per woman by 2015. *TFR* has also decreased from 5.40 in 1988 to 4.10 by 2015. Surprisingly, the *TFR* decline reversed from 3.80 in 2005 to 4.10 in 2010.

In terms of percentages, the impact of each proximate determinant is displayed in Table 2. In 1988 contraceptive and postpartum infecundity accounted for 26% and 25% of fertility reduction, with marriage accounting the least of 19% respectively. Similarly as in levels and trend in absolute *TFR* inhibition effect, in 2015 the fertility reduction effects of marriage and contraception significantly increased to 42% and 22% respectively, whilst the effect of postpartum infecundability decreased to 20% from 26% for the same period. The values in Table 1 also show that the effect of marriage and postpartum infecundability stagnated/reduced in 1994 and 1999, respectively, whilst the effect of contraception significantly increased continuously. This suggests that married women who used contraception contributed the most towards fertility reduction.

Values in Table 3 shows the effects of the proximate determinants on fertility by residence, education and wealth. As noted above, the closer the index to zero or one, the bigger or, the lesser the effect on fertility reduction, respectively. Table 3; reveal contraception fertility inhibition effect increased with time and is positively related to the socioeconomic variables. For example, between 1994 and 2015 contraception inhibition effect of higher educated women increased from 60% to 68% respectively, whilst least educated women contraception fertility inhibition effect increased from had 25% to 42% in 1994 and 2015 respectively. The wealth quintile data collection starts from 1994 and shows that the higher the wealth quintile, the stronger the effect of contraception, for example in 1994 poorest and richest quintiles had 30% and 53%, which increased to 55% and 65% respectively by 2015. Urban areas had higher contraception inhibition effect than rural areas which increased from 47% and 30% to 64% and 56% between 1988 and 2015 respectively. Table 3; shows contraception fertility inhibition stagnation or reversals for period 2010 for most socioeconomic variables. Surprisingly, married women in rural areas, of middle and poorest wealth quintiles did not experience contraception fertility inhibition stagnation for periods under analysis. In 2015, married women with no education were the only socioeconomic groups with fertility contraception inhibition effect below 50% with 42%.

The index of postpartum infecundability was observed to be inversely related to the selected socioeconomic characteristics. The postpartum infecundity, although fluctuating, has slightly increased from 1988 to 2015. For example, in 1988 to 2015 poorest and richest women had 37% and 32% postpartum infecundity, which decreased to 35% to 30% respectively. This suggests that the fertility inhibition effect of post-partum infecundity is higher at lower socioeconomic levels than high socioeconomic levels and have been slightly reduced across all socioeconomic groups over time.

The marriage inhibition index effect on fertility is inversely related to education, urban and wealth

**Tab. 3** Estimated indices for the four principle determinants by selected background variables, 1988–2015, Zimbabwe.

| Index of contraception (Cc) | | 1988 | 1994 | 1999 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|---|---|
| Residence | Urban | 0.53 | 0.49 | 0.42 | 0.37 | 0.45 | 0.36 |
| | Rural | 0.70 | 0.64 | 0.60 | 0.51 | 0.49 | 0.44 |
| Education | No education | 0.76 | 0.75 | 0.68 | 0.72 | 0.62 | 0.58 |
| | Primary | 0.67 | 0.63 | 0.59 | 0.52 | 0.52 | 0.46 |
| | Secondary | 0.50 | 0.48 | 0.45 | 0.40 | 0.46 | 0.39 |
| | Higher | – | 0.40 | 0.38 | 0.30 | 0.40 | 0.32 |
| Wealth Quintile | Poorest | – | 0.70 | 0.62 | 0.58 | 0.52 | 0.45 |
| | Poorer | – | 0.69 | 0.61 | 0.49 | 0.51 | 0.45 |
| | Middle | – | 0.64 | 0.60 | 0.49 | 0.48 | 0.44 |
| | Richer | – | 0.53 | 0.50 | 0.39 | 0.45 | 0.38 |
| | Richest | – | 0.47 | 0.37 | 0.35 | 0.42 | 0.35 |
| **Index of postpartum infecundability (Ci)** | | | | | | | |
| Residence | Urban | 0.68 | 0.67 | 0.64 | 0.68 | 0.68 | 0.69 |
| | Rural | 0.63 | 0.64 | 0.62 | 0.63 | 0.65 | 0.65 |
| Education | No education | 0.61 | 0.62 | 0.62 | 0.62 | 0.63 | 0.65 |
| | Primary | 0.64 | 0.64 | 0.61 | 0.63 | 0.66 | 0.65 |
| | Secondary | 0.69 | 0.66 | 0.65 | 0.65 | 0.66 | 0.67 |
| | Higher | 0.73 | 0.85 | 0.73 | 0.77 | 0.70 | 0.72 |
| Wealth Quintile | Poorest | – | 0.63 | 0.61 | 0.63 | 0.65 | 0.65 |
| | Poorer | – | 0.63 | 0.61 | 0.64 | 0.65 | 0.65 |
| | Middle | – | 0.64 | 0.65 | 0.63 | 0.65 | 0.66 |
| | Richer | – | 0.65 | 0.64 | 0.65 | 0.68 | 0.68 |
| | Richest | – | 0.68 | 0.64 | 0.71 | 0.70 | 0.70 |
| **Index of marriage (Cm)** | | | | | | | |
| Residence | Urban | 0.71 | 0.69 | 0.60 | 0.62 | 0.65 | 0.65 |
| | Rural | 0.72 | 0.69 | 0.62 | 0.62 | 0.63 | 0.62 |
| Education | No education | 0.69 | 0.67 | 0.62 | 0.61 | 0.58 | 0.69 |
| | Primary | 0.70 | 0.66 | 0.59 | 0.60 | 0.61 | 0.60 |
| | Secondary | 0.71 | 0.69 | 0.62 | 0.62 | 0.64 | 0.64 |
| | Higher | 0.82 | 0.77 | 0.65 | 0.64 | 0.73 | 0.72 |
| Wealth Quintile | Poorest | – | 0.69 | 0.61 | 0.62 | 0.62 | 0.62 |
| | Poorer | – | 0.68 | 0.62 | 0.62 | 0.64 | 0.62 |
| | Middle | – | 0.70 | 0.63 | 0.61 | 0.62 | 0.63 |
| | Richer | – | 0.67 | 0.60 | 0.60 | 0.63 | 0.62 |
| | Richest | – | 0.70 | 0.61 | 0.64 | 0.67 | 0.67 |

– missing values
Source: ZDHSs and own calculations

quintiles. However, the marriage inhibition effect across all the selected socioeconomic variables slightly decreased with time (1988-2015). Marital fertility inhibition effect trend is fluctuating between rural and urban areas between 1988 and 2005 rural. However, in 2005 and 2015, slightly higher marital fertility inhibition effect was observed in rural areas (37% and 38%, respectively) than in urban areas (35% and 35%, respectively). Higher educated women had lower marital fertility inhibition than less educated women. Further, there is a general fluctuating but increase in marital fertility inhibition across all educational categories with the least decrease experienced by women with no educated. This suggests education increases are related to marital fertility reduction over time.

## 4. Discussion

The results from the Bongaarts model presented above reveal levels, trends and the impact of proximate determinants of fertility, namely marriage, postpartum infecundability, and contraception for the six consecutive ZDHSs. The results quantify the impact of each proximate determinant in absolute as well as percentage terms to total fecundity and fertility decline in Zimbabwe. The results uncovered that contraception was the most important factor contributing to fertility decline experienced in Zimbabwe by married women from *TFR* of 5.4 to 4.0 in 1988 to 2015 respectively. Precisely, the contraception inhibition effect increased significantly and continuously from 25% to 42%, whilst marital inhibition effect although fluctuating increased from 19% to 22% and postpartum infecundity inhibition effect decreased from 26% to 19% in 1988 to 2015 respectively. A similar trend is observed of fertility (*TFR*) suppression, as presented in Figure 1. This finding concurs with previous studies that found that contraception adoption is the most important factor for fertility decline in Zimbabwe (Mturi and Kembo 2011; Sibanda 1999). Moreover, this finding is consistent with other previous studies in sub-Saharan Africa (Finlay, Mejia-Guevara and Akachi 2018) and Asia (Majumder and Ram 2015). More broadly, the results confirm the hypothesis that contraception adoption is associated with further fertility decline as countries move from non-parity specific fertility to parity-specific fertility regime (Coale 1973).

Further, the decomposition of contraception fertility inhibition by residence, education and wealth quintiles demonstrate a positive relationship. Analysis of change associated with contraception use helps us examine in some limited way whether any increase in the fertility-inhibiting effects of contraception constitute evidence of what Coale (1973) postulated as the necessary conditions for a fertility decline to start: (1) fertility is within the calculus of the conscious choice, (2) lower fertility is seen as advantageous, (3) effective means of birth control are readily available and couples are willing to use them. The idea of using contraception (and socioeconomic variables) to achieve a smaller ideal family size is grounded in van de Walle's concept of numeracy (van de Walle 1992; Sibanda 1999). This suggests that contraception adoption is single proximate determinant responsible for marital fertility decline in Zimbabwe.

In contrast to findings in this study, Palamuleni (2017) and Chola and Michelo (2016) found out that marriage not contraceptive was the most important proximate determinant for fertility inhibition in Namibia and Zambia, respectively. The differences between Zimbabwe and Namibia might be explained by the fact that in Namibia, percentage currently married for women aged 15–49 years was about 25%, whilst in Zimbabwe, it was about 60% for the respective periods. The discrepancy between Zimbabwe and Zambia which have similar marital rates can plausibly be explained by the fact that Zambia is in the early stages of fertility transition (*TFR* 6.2 in 2007) where fertility is more amenable to Malthusian preventative checks (Malthus 1798), while Zimbabwe is in the midway of fertility transition (*TFR* 4.0 in 2005, 2010 2015) where fertility is more susceptible to contraception adoption. This is made possible by increases in the prevalence rate of modern contraceptive use from 36% in 1988 and 66% in 2015 and was responsible for fertility decline (ZIMSTAT and ICF International 2016).

*TFR* at the national level fell from1988 (5.4) to 2005 (3.8) (Figure 1). Thus the fall in *TFR* is well above 10%, a figure that is cited in the historical fertility transitions as a key threshold for entry into non-reversible decline (Coale 1973). However, the fertility levels between 2005, 2010 and 2015 increased from *TFR* 3.8, 4.1 and to 4.0 respectively. This means fertility decline in Zimbabwe stalled, as there was less than 10% sustained *TFR* decline between successive surveys as defined by Bongaarts (2008). The fertility stalling finding in Zimbabwe is in line with other findings in a substantial number of sub-Saharan African countries (Bongaarts 2006; Garenne 2013; Goujon, Lutz and Samir 2015; Lutz, Goujon and Kabat 2015). However, during the respective stalling periods, the overall contraceptive fertility inhibition effects continuously strengthened from 5.35, 5.70 and 6.45 children per woman, respectively. Viewed from this empirical evidence, this suggests that fertility stalling in Zimbabwe has not been caused by a lack of priority assigned to family planning services suggested by (Bongaarts 2008). However, it is plausible that modern contraceptive methods such as condoms were used for HIV prevention rather than for fertility limitation, given high HIV prevalence rate of 17% among women (15–49 years) in Zimbabwe (ZIMSTAT and ICF International 2016).

Results indicated that marital fertility inhibition effects of marriage were the least important of all the proximate determinants in 1988 and 1994 and thereafter became the second important after contraception. Equally important, marital fertility inhibition effects increased from 2.89 to 3.58 children per woman in 1988 and 1999, before declining to 3.29 and 3.32 children per woman in 2005 and 2015, respectively. It is possible that the erosion of the marital fertility inhibition effect might be partly responsible for fertility stalling during 2005 and 2015. This finding is consistent with other studies that have found the erosion of marital fertility inhibition effect as countries move along the fertility transition (Chola and Michelo 2016; Mturi and Kembo 2011; Muhwava and Muvandi 1994; Sibanda 1999). Ministry of Health and Child Care (2016), research show an increase in early teenage pregnancies in Zimbabwe. This is important, considering the gap between marriages and childbearing is very small in Zimbabwe (Chitereka and Nduna 2010; Sayi and Sibanda 2018). Thus, fertility stalling might be due to sustained cultural and traditional practices which promote early marriage and childbearing.

The results show that the index of postpartum infecundability fertility-reducing effect has since decreased from the biggest (26%) in 1988 to the least fertility inhibition effect by 1999 (22%) and continuously thereafter. This is consistent with previous findings in Zimbabwe (Sibanda 1999; Kembo and Mturi 2011) and other countries in the region: Namibia (Palamuleni 2017), in Zambia (Chola and Michelo 2016), Malawi (Palamuleni 1996). This means short breastfeeding possibly contributes to fertility stalling noted above. In India, it was found that the risk of pregnancy increases substantially after giving birth in the absence of breastfeeding (Singh, Suchindran and Singh 1993; Bongaarts and Potter 1983). Besides that, prolonged breastfeeding practices and postpartum abstinence have been used effectively in Africa, not only for birth spacing and subsequently reducing total fertility but also for increased child survival (Guikey and Jayne 1997; Mhloyi 1988). ZIMSTAT (2015) notes higher infant mortality among employed than unemployed women in Zimbabwe, which is plausibly related to inadequate and short breastfeeding by employed women. Child survival is considered a principal component of fertility decline (Coale 1973; Dyson 2013). This suggests that the promotion of universal breastfeeding among women can contribute to significant fertility decline through postpartum amenorrhea and increased child survival.

The analysis of education and wealth quintiles shows an inverse relationship with marriage and postpartum infecundability. Rural women have generally had higher postpartum infecundity and marriage fertility reduction effect than urban areas. The fertility inhibition effect of the selected socioeconomic variables generally increased, although they were fluctuating. This corresponds with what emerged from other researches in Zambia (Chola and Michelo 2016), Uganda (Rutaremwa et al. 2015) and Ethiopia (Alazbih, Tewabe and Demisse 2017) and sub-Sahara Africa (Finlay, Mejia-Guevara and Akachi 2018). This could be attributed to the effects that marriage and wealth have on fertility.

The effect of contraception was positively correlated with regard to education, wealth and residence. Furthermore, contraceptive fertility reduction effect increased with time across all socioeconomic groups (rich or poor, educated or not, urban or rural). These results are consistent with other findings that show that contraceptive inhibition effect of fertility from biological maximum is greater among high socioeconomic groups than lower socioeconomic groups; in Uganda (Rutaremwa et al. 2015), Namibia (Palamuleni 2017), Ethiopia (Alazbih, Tewabe and Demisse 2017) and Zambia (Chola and Michelo 2016). This could imply that women empowerment (access to education especially tertiary, female employment, poverty alleviation) could be powerful tools for fertility decline.

An interesting finding is a decrease in the effect of contraception fertility inhibition across all socioeconomic groups in 2010. Although such a finding was not revealed when looking contraceptive inhibition effect without background variables. Nonetheless, the decomposition of contraception effect by socioeconomic variables could partly explain fertility stalling noted above. This finding is consistent with findings from ZIMSTAT Census (2012) Nuptiality and Thematic report which found that fertility stalling could have been caused by fertility postponement in earlier during periods of economic hardships and the fertility rebounded when the economy stabilized in 2009 (ZIMSTAT 2015).

Moreover, the contraceptive fertility inhibition gap between and within each socioeconomic group is narrowing. However, women with no education are lagging behind, e.g. in 2015, they had contraception inhibition effect of 42% when other socioeconomic variables are below 64%. This is in line with the van de Walle's (1992) concept of numeracy discussed above. Similar studies also highlight the importance of mass education in fertility decline in developing countries (Goujon, Lutz and Kabat 2015). The narrowing of the contraceptive fertility inhibition gap between socioeconomic variables might suggest better future prospects for fertility decline. The strengthening contraception fertility inhibiting effect among women of low socioeconomic classes means that it is possible for fertility to decline in the low socioeconomic development environment. This is consistent with findings in other developing countries in Latin America (Bongaarts 2014) and also a phenomenon witnessed in the French fertility revolution (Pavlík and Hampl 1975). These results suggest empowerment of women might be necessary through female education and access to resources.

The study has a number of strengths. The study used a large, nationally representative population-based sample conducted over 30 years. The data has a high response rate above 90%, standardized surveys as enabling comparisons across countries and periods. The decomposition of proximate determinants was done in order to understand sources of fertility changes over time.

The study also had a weakness. The index of abortion was taken as one throughout the analysis, i.e. induced abortion was assumed to have no significant fertility inhibition effect on fertility due to lack of data. It is possible that excluding abortion in the model could have affected the estimation of total fecundity. Furthermore, studies have shown that abortion rates in sub-Saharan Africa are growing rapidly (Alazbih, Tewabe and Demisse 2017; Remez, Woog and Mhloyi 2014). Another limitation of the data used is that it failed to include reproductive data of males. Moreover, the surveys collected retrospective data on women's birth history. It is possible that such respondents might suffer from recall bias which might affect the accuracy and validity of the data. Thus predicted *TFR* will normally differ from the observed *TFR* because of underreporting of births; misreporting of behaviours measured by the indices or omission of proximate factors that help determine fertility levels in the population under study.

## 5. Conclusion

In this paper, we applied the Bongaarts model to assess and compare changes in the relative importance of proximate determinants of fertility for six ZDHSs conducted in Zimbabwe. The results indicate that the fertility inhibition effects of contraception are the most important than the inhibition effects of marriage, and postpartum infecundability in Zimbabwe. Moreover, the results show that the contraceptive patterns vary positively with education, wealth quintiles and areas of residence. There was a gradual erosion of post-partum infecundability through the analysis period and of marriage after 1999. It is plausible that the fertility stalling could have been caused by the cumulative effects of marriage and postpartum infecundability. The findings of this study have important policy implications. The strengthening of fertility inhibition effects of contraception, late marriage, and prolonged breastfeeding must be promoted. There is a need to research further on proximate determinants of fertility according to age groups as such research can illuminate the age-specific reproductive contributions of fertility.

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