Fertility Levels and Trends in Botswana

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Abstract

Several African countries, Botswana inclusive, are experiencing fertility transition. Therefore, the purpose of this study is to establish fertility levels, trends and differentials using the census data from 1971 to 2011. The 2011 total fertility rate was estimated using Arriaga method. Botswana's total fertility rate (TFR) continues to decline from a high of 6.6 children per woman in 1981 to 3.3 in 2001 and to 2.8 children per woman in 2011. Most of the fertility decline between 2001 and 2011 is accounted for by the decrease in the fertility of the 15-29 year olds. Fertility rates of women residing in urban areas and those employed are consistently lower than those of their counterparts, which is consistent with previous research findings. The estimated TFR of Botswana for 2011 resonates with those of other Southern African countries. The sustained declines in fertility in Botswana combined with declining mortality have economic, health, educational and labour implications for the country. Therefore, appropriate policy directions that take into account these priorities are called for.

Introduction

The current chapter presents an analysis of the Botswana 2011 Population and Housing Census (PHC) data to establish fertility levels, differentials and trends in the country. It is hoped that the analysis will facilitate effective planning, implementation and monitoring of projects and programmes that are affected by fertility patterns.

The paper is organised into various sections. The first section provides a brief background on population trends including fertility in Botswana. The second is an outline of the current trend in the levels and differentials of fertility in Botswana. The third section describes how and why the census collected fertility data the way it did. The fourth section discusses different methods that could be applied to the data to derive estimates of fertility. This discussion is immediately followed by the results section that presents the estimates of total fertility rate (TFR). The last section discusses how the estimates fit in the existing trend of fertility levels in Botswana.

Demographic Context

Botswana's *de facto* population increased from 596,944 in 1971 to 941,027 in 1981 to 1,326, 796 in 1991 to 1,680,863 in 2001 and 2,024,904 in 2011. Previous studies on the levels and trends of fertility in sub-Saharan Africa heralded three countries (namely Botswana, Zimbabwe, and Kenya) as the pioneers of the fertility transition that is currently underway in the region (Kirk and Pillet 1998; Kalipeni 1995; Rustein and Blanc 1994; Thomas and Muvandi 1994; Cohen 1993; Freedman and Blanc 1992; Caldwell *et al*1992; and Cross *et al* 1991). Fertility began to decline in Botswana and Zimbabwe in the 1970s, while in Kenya the decline was first observed in the 1980s (Anderson 2003). The TFR of Botswana decreased from 6.8 in 1970 to 3.1 in 2007 (Anderson 2003; Population Reference Bureau 2007).

The 2006 Botswana Demographic Survey (BDS) showed that the country's TFR fell by more than three points between 1971 and 2001, from 6.5 to 3.3 births per woman. Between 1971 and 1981 it increased slightly from 6.5 to 6.6 births per woman. In 1981 the TFR started a sustained decline,

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falling from 6.6 to 3.3 births per woman in 2001 and further declined slightly to 3.2 births in 2006 (Central Statistics Office 2009). It is evident from this discussion that overall, Botswana is a country of a relatively low and declining fertility.

Fertility Data

In developing countries, Botswana included, complete reporting of vital events remains a challenge. Therefore, demographic parameters such as the TFR are estimated from household surveys or census data. Direct estimation of fertility levels from survey or census data from developing countries is often impossible because data obtained from questions on current fertility (for example births in the last 12 months before enumeration date) are usually fraught with problems. Generally, these data tend to yield lower age-specific fertility rates (ASFR), especially among younger women (Feeney 1998). This consequently leads to lower estimates of TFR than is the case. The problem is addressed by employing indirect estimation techniques that involve applying some multipliers (derived from parity data) to adjust the observed ASFRs to arrive at a more reliable approximation of TFR (United Nations 1983).

Firstly, the 2011 census collected the two pieces of information required for indirect estimation of fertility. Parity data were gathered by asking women aged between 12 and 49 years at the time of enumeration what are commonly referred to as Brass-type questions. These are questions on parity/ total number of children (live births) ever born (CEB), and its components, children surviving and children dead. Secondly, the 2011 census asked the women to provide the full date (day, month and year) of their last birth. This information can be used to derive the number of births that occurred within the last 12 months into the survey and hence facilitate the calculation of ASFRs and the TFR.

In an attempt to address the problems that were encountered with parity data in the past (for example women reporting surviving children as total children ever born), the 2011 census asked detailed filtering questions for each of the components that constitute the total number of children ever born. Thus, in addition to responses to the question on the total number of live births that a woman had experienced at the time of enumeration, she was also asked to report on the total number of children that are male and those that are female. In addition, the woman was asked to report, by sex of the child, the total number of children that live with her in the household in which she was enumerated and the number living elsewhere. Finally, she was also required to give the total number of her children that had died and disaggregate the number by sex of the children.

Methods Used to Estimate Fertility Levels

Several techniques could be employed to indirectly estimate fertility levels from parity and current fertility data as obtained in the 2011 census. The main techniques are discussed below.

The P/F Ratio Method

The P/F ratio method is based on the following assumptions: 1) fertility has been constant in the recent past; 2) the level of underreporting of births in the year prior to the census/survey does not vary by age; 3) data on CEB for younger women (up to 35 years of age) are more completely reported than births in the previous year (Feeney 1998 and United Nations 1983); and 4) age misreporting among women of childbearing ages is negligible. The assumptions do not quite hold in the current Botswana situation. For instance, the crucial assumption of constancy of fertility in the period immediately before a census/survey data collection is not true for the country's population. Several studies have shown that fertility has been declining in the country since the 1980s (CSO 2009; Letamo and Gaisie 1999; Thomas and Muvandi1994; Rutenberg and Diamond 1993). This trend is corroborated by the average parities shown in Bainame and Letamo (forthcoming) which indicate that fertility continued to decline during the period 1996–2006.

Some refinements to the method have been proposed. These include the Feeney (1998) approach and the Synthetic cohort P/F ratio method. The calculated P/F ratios indicate that the P/F ratio method cannot be used to adjust ASFRs as the ratios are three times above unity which could indicate the declining fertility. Some of the indirect techniques require certain assumptions regarding the past course of fertility. For example, the Brass P/F Ratio method requires fertility to have remained unchanged. If this method is applied to data when fertility has been declining, as is currently the case in Botswana, it overestimates current fertility. The estimated TFR from P/F Ratio method was 3.2 based on the adjustment factor of averages of P_3/F_3 and P_4/F_{4n} which is highly likely to be an overestimate. Therefore, it was decided that because one of the key assumptions of the P/F ratio method has been violated, it cannot be used to provide reliable fertility estimates in the context of Botswana.

The Gompertz Relational Method

The method fits a Gompertz function to data on average number of children ever born or ASFRs by age of women. The advantage of the method is that it provides estimates of TFR based on each 5-year age group in childbearing ages which allows for inferences about trends in the level of fertility (Arriaga 1994). Another attractive property of the Relational Gompertz method is that it is flexible enough to fit good data well but bad data badly (Udjo 2009). The main limitations of the method include: 1) the results obtained by applying the method are highly sensitive to errors in the reported numbers of children ever born by women; 2) estimates based on data for women aged 15–19 years are not reliable because data for these ages are sensitive to information errors; 3) the method is only well suited for populations with medium to high fertility (Paget and Timæus 1994 and Booth 1984). Estimates derived from Gompertz relational method is rather high (see Table 1 below). As such this method is not used to estimate fertility for Botswana.

Table 1: Calculation of corrected fertility rates using Gompertz Relational Method, Botswana 2011

		P_2/F_2	P_3/F_3	P_4/F_4	Avg (P_3/F_3, P_4/F_4)
Age	**ASFR**	-1.223	-1.115	-1.1	-1.108
15-19	0.039	0.0591	0.0538	0.0531	0.0535
20-24	0.138	0.1744	0.159	0.1569	0.158
25-29	0.137	0.1659	0.1512	0.1492	0.1502
30-34	0.117	0.1396	0.1272	0.1256	0.1264
35-39	0.090	0.1055	0.0961	0.0949	0.0955
40-44	0.045	0.0496	0.0452	0.0446	0.0449
45-49	0.014	0.0138	0.0126	0.0124	0.0125
TFR	**2.8934**	**3.5391**	**3.2256**	**3.1838**	**3.2047**

Source: Statistics Botswana (2011)

Methods Used to Estimate TFR

The Arriaga Method

Unlike the P/F ratio method the Arriaga (1983) method does not make the assumption of constancy of fertility in the period preceding a survey/census. Based on a simulation model, Arriaga (1994) shows that under conditions of declining fertility the number of children ever born by age of mother changes linearly for mothers under 35 years of age. This observation and the fact that parity reports for women under 35 years of age are usually of good quality allow for linear interpolation of the data on children ever born per woman by age of mother from two or more censuses/surveys to derive estimates of children ever born for a one year prior (or posterior) to the date of the census/survey (Arriaga 1994).

Thus, having information on the average number of children ever born per woman by age of mother for two consecutive years, the cohort differences between them for each single year of age of the female population represent ASFRs by single year of age.

The method is affected by misreporting of children in older ages. However, as with the P/F ratio method if an age pattern of fertility is available such a pattern can be adjusted to the fertility level implied by the fertility rates derived from the information on children ever born. We use the Arriaga technique to indirectly estimate TFR for 2011 alongside the direct TFR estimate on the basis that it serves to be a superior method than the P/F Ratio method on account it does not conform to the assumption that fertility must have been constant in the recent past.

Results

The fertility estimates presented according to levels, trends and differentials were derived from the Arriaga method. All other fertility estimation methods were considered inadequate especially where the method assumptions were violated.

Fertility Levels

Table 2 below shows estimates of fertility based on the Arriaga method with adjusted ASFRs based on different age groups. According to the estimates of fertility based on the Arriaga method, total fertility rate for Botswana in 2011 was estimated to range from 2.7 to 3.0 depending on the age group used to adjust the ASFRs data. However, the estimated TFR for Botswana is 2.78 derived from the adjusted ASFR and TFR based on women 25-34 because the technique recommends the adjustment factor close to mean age at childbearing which is 29.9 years. If the adjustment factor used to adjust ASFRs is for women aged between 25 and 29 years then the estimated TFR would be almost the same as the reported TFR, which are 2.898 and 2.893, respectively.

Table 2: Age-Specific Fertility Rates and Total Fertility Rates, by Maternal Age, Botswana 2011

Age group		**Adjusted ASFRs based on age group**			
	Reported ASFR	**20-29**	**25-29**	**25-34**	**30-34**
15-19	0.039	0.0412	0.0391	0.0375	0.0360
20-24	0.138	0.1454	0.1378	0.1323	0.1269
25-29	0.137	0.1446	0.1370	0.1316	0.1262
30-34	0.117	0.1232	0.1167	0.1121	0.1075
35-39	0.090	0.0948	0.0898	0.0863	0.0827
40-44	0.045	0.0471	0.0447	0.0429	0.0411
45-49	0.014	0.0152	0.0144	0.0139	0.0133
Total Fertility Rate	**2.893**	**3.057**	**2.898**	**2.783**	**2.669**
Mean Age	**29.85**	-	-	-	-

*Using Arriaga fertility estimate with adjusted ASFRs based on age group 25-29 which is 0.963.

Source: Statistics Botswana (2011)

The TFR estimate is plausible because it is consistent with fertility trends in the Southern African region. For instance, South Africa's national TFR was estimated to be 2.8 and for the Black population TFR was 2.9 in 2006 (Statistics South Africa 2010) and 2.43 in 2011. Namibia's TFR was estimated to be 3.2, Zimbabwe 3.2, Lesotho 3.1 and Botswana 2.7 in 2011 (World Bank 2013). Therefore, Botswana's TFR of 2.8 in 2011 appears to be a plausible estimate.

Fertility Trends

Data from the previous censuses show that fertility has been declining since the 1980s. Total fertility rate (TFR) was 6.6 children per woman in 1981 and decreased to 4.2 in 1991, 3.3 in 2001 and 2.8 in 2011 (see Table 3 below). Thus fertility decline has been sustained since the 1980s. An analysis of the age-specific fertility rates (ASFRs) show a substantial decrease in the 15-29 year-olds particularly between 2001 and 2011.

Table 3: Reported Age Specific Fertility Rates and Total Fertility Rates: 1971-2011

Age group	**1971**	**1981**	**1991**	**2001**	**2011***
15-19	0.0955	0.1015	0.0536	0.0533	0.0375
20-24	0.2778	0.2599	0.1340	0.1713	0.1323
25-29	0.2760	0.2504	0.1338	0.2021	0.1316
30-34	0.2432	0.2336	0.1191	0.1296	0.1121
35-39	0.1983	0.1902	0.1023	0.0686	0.0863
40-44	0.1383	0.1341	0.0641	0.0258	0.0429
45-49	0.0709	0.0837	0.0358	0.0032	0.0139
TFR	**6.5**	**6.6**	**4.2**	**3.3**	**2.8**

*Using Arriaga fertility estimate with adjusted ASFRs based on age group 25-29 which is 0.963.
Source: Statistics Botswana (2011)

The completed family size is the number of children ever born by the end of the reproductive period of a woman's life. It tends to exhibit much more stability than do age-specific fertility rates from year to year. Usually, the average parity of women aged between 45 and 49 is taken to represent the completed family size with the assumption that fertility of older cohorts are equal to the current fertility experience of women in childbearing ages. Evidence from Table 4 buttresses the consistent fertility decline since the 1980s. It is clear from Table 4 that both the completed family size and the TFR show a sustained decline since 1981. The completed family size shows that fertility declined from 6.5 children per woman in 1981 to 4.0 in 2011. TFR shows fertility declined from 6.6 in 1981 to 2.8 births per woman in 2011.

Table 4: Comparison of Completed Family Size and Total Fertility Rates by Age of Women: 1971-2011

	Age of women							
Year of Census	15-19	20-24	25-29	30-34	35-39	40-44	Completed family size 45-49	TFR
1971	0.16	1.33	2.77	4.12	4.93	5.48	5.6	6.5
1981	0.26	1.46	2.76	4.16	5.24	6.15	6.5	6.6
1991	0.18	1.12	2.27	3.49	4.60	5.56	6.1	4.2
2001	0.13	0.85	1.68	2.65	3.60	4.56	5.3	3.3
2011	0.10	0.73	1.44	2.12	2.75	3.38	4.0	2.8*

*Obtained using Arriaga indirect estimation method. *Source:* Statistics Botswana (2011)

Fertility Differentials

Fertility differentials could be presented for the place of residence and employment status only because other characteristics had data problems resulting in implausible results. Table 5 shows the TFRs and mean number of children ever born to women aged from 45 to 49 years by place of residence and employment status. As expected the fertility of women living in urban areas were much smaller than that of women residing in rural areas, for both the TFR and mean children ever born. Most of the difference between rural and urban fertility rates was a result of higher ASFRs among rural residents aged from 15 to 24.

Table 5: Total fertility rates and mean number of children ever born by urban-rural residence, women's employment status, and marital status, Botswana 2011

Characteristic	Age specific fertility rates							Total fertility rate	Mean number of children ever born (45-49 years)
	15-19	20-24	25-29	30-34	35-39	40-44	45-49		
Residence									
Rural	0.0408	0.1519	0.1435	0.1208	0.0936	0.0460	0.0148	**3.1**	**4.2**
Urban	0.0248	0.0886	0.1137	0.1017	0.0747	0.0369	0.0110	**2.3**	**3.1**
Employment status									
Not working	0.0347	0.1448	0.1655	0.1461	0.1142	0.0592	0.0178	**3.4**	**4.5**
Working	0.0741	0.1031	0.1113	0.1033	0.0813	0.0384	0.0126	**2.6**	**3.6**

Source: Statistics Botswana (2011)

From the information in table 5, it is also evident, using both the TFR and mean number of children ever born that fertility is lower among women who reported that they were employed at the time of the census. This finding is consistent with other studies on this issue.

Discussion

Data from the 2011 population census appears good enough to enable direct estimation of fertility. The direct estimate of TFR is 2.9 which is similar to the 2.8 derived from the indirect estimation using the Arriaga method of fertility. The results of this analysis demonstrate that fertility in Botswana continues to decline from a high of 6.6 children per woman in 1981 to 3.3 in 2001 and to 2.8 children per woman in 2011. Most of the fertility decline between 2001 and 2011 is accounted for by the decrease in the fertility of the 15-29 year-olds. Fertility rates of women residing in urban areas and those employed are consistently lower than those of their counterparts which is consistent with previous research findings. The estimated TFR of Botswana for 2011 is resonate with those of other Southern African countries such as South Africa, Namibia and Zimbabwe.

Several other studies have shown that fertility has been declining in the country since the 1980s (CSO 2009; Letamo and Gaisie 1999; Thomas and Muvandi 1994; Rutenberg and Diamond 1993). The sustained decline in fertility in Botswana has a huge importance in the change and shape of the population structure. The shift in the age structure contributes to a decrease in the proportions of the population under 15 years and an increase in the proportion of the population between 15 to 64 years. In other words, this phenomena of 'falling birth rate makes for a smaller population at young, dependent

ages and for relatively more people in the adult age groups—who comprise the productive labour force' (Ross 2004). The emergence of the new fertility dynamics allows for improvements in the ratio of productive workers to child dependents in the population –called the demographic dividend (Ross 2004). In essence Ross (2004) argues that this allows for faster economic growth and fewer burdens on families.

Like many other developing countries the demographic dividend represents an opportunity for Botswana to experience a period of accelerated economic growth as a result of population change. This will come in the form of investments of increased income from a working 'youth bulge' with fewer dependents behind it, and from prolonged investments in the economy of increased savings from cohorts moving into the older years (ECA and AUC 2013).

Policy Implications

The economic benefits of the demographic dividend do not accrue automatically. Governments need to develop and implement appropriate policies to take advantage of the demographic dividend. The following is a brief of possible policies that can assist the country to realize the demographic dividend.

Health policies

Botswana needs to ensure sustained availability of voluntary family planning services and products in order to facilitate sustained fertility declines. Evidence from existing studies is that contraceptive use and fertility are inversely related to each other (Bongaarts 1997). For instance, one study found that fertility declines by an average of one to two children per woman following a rise of 16 percentage points in the contraceptive use rate (ECA 2013). As such investing in voluntary family planning is critical for fertility declines.

Educational policies

Investing in female education and prolonged educational attainment helps countries to reap economic growth benefits. The benefits of promoting female education and the increase in enrolment and attainment include increased participation in the workforce, income earnings and economic revenues, status of women and individual efficacy (ECA 2013). Additionally, better female education improves household health and nutrition and management of sick children and prevention of unintended pregnancies (ECA 2013).

The educational policies should also aim to promote the supply of a large and highly educated labour force which can easily be integrated into economic sectors (Lin 2012). Skills specific to a country's strongest growing economic sectors need to be identified and training for the acquisition of such skills should be the focus of educational and employment programmes (ECA 2013).

Labour policies

The creation of new jobs in expanding economic sectors needs to be synchronised with the production of skilled labour. Regulations should create a flexible job market to facilitate the absorption of the youth bulge into the growing sectors of the economy (Bloom, Canning and Sevilla 2003). Deliberate efforts to promote gender-neutral hiring practices should be designed to target the growing number of females seeking participation in the workforce (Bloom, Canning and Sevilla 2003). Supporting the development of local or indigenous entrepreneurs with the capacity to work with their foreign counterparts in mutually beneficial business relationships is important.

Fiscal policies

ECA (2013) states that different types of fiscal policies have been found to favour increased capital

accumulation needed to fuel growth. One of the key factors determining the accrual of capital formation is the establishment of free trade which have been observed to create higher rates of return on investment, mainly because of the market flexibility and structural capacity for expansion (Bloom, Canning and Sevilla 2003). Diversification of trade portfolio away beyond agricultural materials and minerals to reduce vulnerability to commodity price fluctuations is critical (ECA 2013). This move can solidify long-term growth which will promote additional external investments and allow for increased share in emerging markets.

It is also imperative to create favourable economic conditions for local savings and foreign investments by reducing the costs of doing business in the country (ECA 2013).

Conclusion

The study indicates that fertility levels have been declining since the 1980s in Botswana, from a high of 6.6 children per woman in 1981 to 2.8 children in 2011. It is also evident from the study that fertility rates vary by residence and employment status where rural residents and the unemployed tend to have higher fertility rates. These changing fertility rates combined with changing mortality rates have socio-economic implications articulated above. In conclusion the following policy actions are recommended for harnessing the economic benefits of the demographic dividend: investing in higher quality education and larger quantity of education opportunities to match economic opportunities is required; investing in the creation of new jobs in growing economic sectors and the development of an adaptive labour market; and investing in fiscal frameworks to fuel capital accumulation for growth (ECA 2013).

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