Fertility Decline in Zimbabwe

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Abstract

The extent to which fertility has declined in Zimbabwe has been hotly debated. This paper attempts to resolve this controversy by conducting a comprehensive analysis of all the fertility data available from national censuses and surveys. This includes the first in-depth analysis of the 1994 Demographic and Health Survey data and the first combined analysis of all enquiries since 1969. As well as examining summary measures of total fertility, the study presents estimates of parity progression for each cohort interviewed in the two DHS surveys using the method proposed by Brass and Juarez to adjust for truncation bias. In addition, we check our fertility estimates against the Census enumerations by carrying out an intercensal population projection based on them.

The results suggest that fertility fell slightly during the civil war of the 1970s but may have risen briefly immediately after independence. At about the time that family planning services were made available to the whole population, a more sustained fertility decline began. This has continued into the 1990s. We agree with those that claim that the two DHS surveys underestimate current fertility. However, so do earlier enquiries. Thus, adjustment of the data leaves unaltered the conclusion that total period fertility has fallen by about a third. The total fertility rate in 1994 in Zimbabwe was about 4.7 children per woman.

Ages at the onset of childbearing have been rising in Zimbabwe. This accounts for part of the decline in period fertility. Most of the decline, however, is due to decreases in parity progression. These began at high parities early in the 1980s and spread very rapidly down to lower-order births. Progression to fourth and higher-order births had fallen by more than 25 per cent by 1994. Fertility in Zimbabwe is incontrovertibly in transition.

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1. INTRODUCTION

1.0 Background

Fertility transition in sub-Saharan Africa has lagged behind that in other regions of the world and this lag is reflected in higher fertility rates in sub-Saharan Africa than other regions. The pattern of fertility change now emerging in sub-Saharan Africa is different from that in Europe, Latin America and Asia. Fertility and mortality rates declined simultaneously in Latin America and Asia. For example, between 1965 and 1985, both mortality and fertility fell substantially in Latin America and Asia, regions which have economic similarities with sub-Saharan Africa. But, in Africa, only mortality fell during this period. Fertility remained stable and high, resulting in rapid population growth at more than 3 per cent per year.

The most important question raised is whether Africa is more resistant to fertility changes than other regions and why this might be so. Attempts to answer this question have led to the accumulation of literature on the subject of fertility decline in sub-Saharan Africa (Boserup 1985; World Bank 1986, Caldwell and Caldwell 1987, 1988 and 1990; Lesthaeghe 1989; van de Walle and Foster 1990, Caldwell et. al. 1992, Cleland 1985, Cleland and Wilson 1987). A brief review of this literature is presented to highlight key findings and identify methodological aspects that need to be addressed in order to better understand the determinants of fertility decline in Sub-Saharan Africa, in general, and Zimbabwe, in particular.

Estimating fertility levels for the period before 1960 in Sub-Saharan Africa is difficult since demographic data for that period are lacking. Even in countries where censuses were undertaken, these are unreliable and of limited content as the motives for their collection were far removed from demographic analysis. However, with the conduct of more censuses and surveys and advances in methods of demographic estimation, a reasonable picture of fertility trends subsequent to 1960 can be constructed. Little change occurred in fertility in the period before 1980 as shown in Table 1.1.

United Nations' estimates suggest that the total fertility rate in Africa declined only by 1 per cent between 1970-75 and 1975-80 and by only about 2 per cent between 1965-70 and 1970-75. These changes are insignificant and could be attributable to errors in these estimates. However, significant changes have been recorded in some subregions of Africa in the period 1985-90, with substantial declines in fertility being registered in North and Southern Africa.

Table 1.1 Percentage Change in Total Fertility Rates for Developing Regions

REGION	Percentage Change				
	1965/70-1985/90	1965/70-1970-75	1970/75-1975-80	1975/80-1980/85	1980/85-1985/90
All Regions	-35	-10	-16	-7	-8
Asia	-39	-11	-20	-7	-8
East Asia	-57	-19	-37	-13	-6
Southeast Asia	-36	-8	-9	-13	-11
South Asia	-22	-3	-8	-2	-10
West Asia	-20	-5	-7	-4	-5
Latin America	-38	-10	-12	-10	-13
The Caribbean	-41	-13	-20	-9	-7
Central America	-41	-5	-18	-13	-14
South America	-37	-12	-9	-10	-13
Africa	-7	-2	-1	-2	-2
East Africa	-1	1	1	-3	1
Central Africa	7	3	2	2	0
North Africa	-26	-7	-5	-6	-10
Southern Africa	-24	-6	-6	-6	-9
West Africa	0	0	0	0	0

Source : United Nations (1993)

While the United Nations' estimates are comprehensive they are sometimes based on unreliable data. The Demographic and Health Surveys (DHS) yield better data, which are comparable across the countries surveyed. Fertility trends in Sub-Saharan Africa are presented in Table 1.2 for those countries which participated in the Demographic and Health Surveys up to 1990.

Uganda is the only country in the DHS-I programme for Sub-Saharan Africa which shows an increase in the total fertility rate. The remaining ten countries show some decline although this varies in magnitude, ranging from 1.2 children per woman in Zimbabwe to 0.4 in Ghana. Cohen (1993) identifies two groups of countries where fertility has declined significantly. Kenya, Botswana and Zimbabwe form Group A, where fertility transition is undoubtedly underway and contraceptive prevalence rates are high. Group B consists of Burundi, Mali, Nigeria, Senegal and Togo. In these countries statistically significant declines in fertility have been noted but these are not accompanied by changes in proximate determinants, that is an increase in the median age at marriage or an increase in contraceptive prevalence.

Table 1.2 Fertility Trends from the Demographic and Health Surveys.

Region and Country	Year	Total Fertility Rate: 0-3 Year Before Survey	Total Fertility Rate: 4-7 Years Before Survey	Change: Absolute	Change: Percent
West Africa					
Ghana	1988	6.1	6.4	-0.3	-5.8
Liberia	1986	6.4	6.8	-0.4	-5.9
Mali	1987	6.8	7.7	-0.9	-11.2
Nigeria	1990	5.9	6.9	-1.0*	-18.1
Senegal	1986	6.4	7.6	-1.2*	-15.6
Togo	1988	6.2	7.2	-1.0*	-13.3
Eastern Africa					
Burundi	1987	6.5	7.4	-0.9*	-12.4
Kenya	1988/89	6.5	7.1	-0.6*	-8.9
Uganda	1988/89	7.2	7.1	+0.1	+1.0
Zimbabwe	1988/89	5.3	6.6	-1.3*	-18.9
Southern Africa					
Botswana	1988	4.8	5.6	-0.8*	-14.0

* Significantly different at the 5 per cent level
Source : Cohen (1993).

While all the countries presented in Table 1.2 except Uganda show evidence of fertility decline, the explanations suggested for these declines vary between different authors. For example, Rutenberg and Diamond (1993) explain the fertility decline in Botswana as a temporary response to the drought. Van de Walle and Foster (1990) discuss the possibility that fertility decline during the 1970s in Ghana was a ‘crisis-led fertility decline’ resulting from the declining economy. According to Lesthaeghe (1989), ‘the hypothesis of a crisis-led transition clearly relies on the argument of frustrated aspirations brought about by rising costs of childbearing, reduced prospective utility of educated children, and declining opportunities for adults in general’. Other authors have interpreted some of these declines as representing the onset of fertility transition (Caldwell *et al*. 1992; Bertrand *et al*. 1993; Lockwood 1994; Brass and Jolly 1993; Cleland *et al*. 1994; Mbacké 1994).

Studies which have examined fertility decline in Zimbabwe have come up with contradictory evidence. For example, Thomas and Muvandi (1994a, 1994b) suggest that data from the 1984 Zimbabwe Reproductive and Health Survey and the 1988 Zimbabwe Demographic and Health Survey are not comparable since the two surveys employed different sample designs. In the 1988 ZDHS, more educated women were interviewed than in the earlier survey. This could have exaggerated the extent of fertility decline. This view has been contested by Blanc and Rutstein (1994) who point out that the difference in educational levels between the two surveys is not statistically significant. On the other hand, another study of the 1988 data (Udjo 1996) concludes that fertility decline has been modest in Zimbabwe. We believe that Udjo's (1996) conclusions are based on life table estimates of parity progression, B_{60}s, which are 'appreciably biased because the women who have attained any birth order are overweighed by faster breeders with a higher B_{60}' (Brass and Juarez 1983). In this study, appropriate methods which adjust for this bias are used.

1.1 Objectives

Fertility in Zimbabwe, like the rest of Africa, remained high until the 1980s. However, a number of recent studies have shown that fertility has started to decline in Zimbabwe (Mhloyi 1991; van de Walle and Foster 1990; Foote et. al. 1993; Freedman and Blanc 1992). The initiation of fertility transition in Zimbabwe and other Sub-Saharan African countries, for example Kenya and Botswana, has raised the question of what factors have contributed to fertility decline in these countries. Study of the fertility decline that has been observed in Zimbabwe may provide useful information for the formulation of programmes and policies intended to facilitate a fertility transition in other parts of Sub-Saharan African.

Most of the evidence of a fertility decline in Zimbabwe is based on the 1988 ZDHS as no detailed analysis of the 1994 ZDHS has been published previously. Uncertainties remain as to extent to which the changing fertility pattern in Zimbabwe reflects changes in the timing or spacing of births. This study investigates whether the fertility decline has been due to changes in the onset of reproduction, the spacing of births or the proportion of women reaching high-order parities by undertaking a detailed analysis of parity progression in the 1988 ZDHS and 1994 ZDHS.

The specific objectives of this paper are:

1. To investigate fertility trends in Zimbabwe using all the data available (1969, 1982 and 1992 Censuses, 1984 Zimbabwe Reproductive and Health Survey, 1987 Intercensal Demographic Survey and the 1988/89 and 1994 ZDHS).
2. To investigate whether the fertility transition observed in Zimbabwe is a result of changes in the onset of reproduction and of spacing and/or stopping patterns using birth history data from the 1988 and 1994 ZDHS.

3. To compare and contrast socio-economic differntials in fertility in the 1988 and 1994 ZDHS and to examine whether the effects of the various covariates change over time.

1.2 Country Background

The census returns of 1992 counted 10.4 million people in Zimbabwe. The population has increased from 7.6 million in 1982, resulting in an increase in population density from 19 persons per square kilometre in 1982 to 27 persons per square kilometre in 1992. Population growth has been high in Zimbabwe for the whole of this century. Average annual population increase has been above 3 per cent since the 1930s. The population age structure is young, indicating a history of high fertility and declining mortality. The results from the 1992 census show that 45 per cent of the population is aged under 15 years and only 3 per cent is aged 65 and over.

By the late-1980s Zimbabwe was one of the countries in Sub-Saharan Africa with the lowest mortality levels (World Bank 1989). According to the Central Statistical Office, life expectancy at birth is over 60 years. Infant mortality declined from 83 infant deaths per 1000 live births in 1978 to 66 in 1990. Data from the 1988/89 ZDHS indicate that 96 per cent of the children aged 12-23 months are immunized. According to the 1988 ZDHS, antenatal care and tetanus toxoid injections have been given to 91 per cent of mothers.

The government has been committed towards achieving ‘health for all by the year 2000' by providing an integrated health system which provides a full range of services, both curative and preventive. The services provided by the Primary Health Care programme include maternal and child health, health education, nutrition education, an expanded programme of immunization, communicable disease control, water and sanitation, an essential drugs programme and the provision of basic and essential preventive and curative care. However, it is not clear whether these favourable health conditions will continue to prevail due to the increase in HIV/AIDS and possible impact of structural adjustment programmes, which have resulted in the introduction of hospital fees.

The history of population-related policies in Zimbabwe parallels its political history. Prior to independence (1980), the white settler government did not provide information on the black population and most censuses were confined to the non-black population. Thus, there was inadequate information for formulating a national population policy. After independence however, the new government commissioned a number of studies concerned with population issues. Although these initiatives have moved the government towards a national population policy, no explicit policy exists at the moment.

Other policies have been formulated which have an impact on fertility. These include the Legal Age of Majority Act No.15 (1982), which aims to emancipate African women over the age of 18 years from their fathers in matters of marriage, and the Matrimonial Causes Act No.33 (1982), which is aimed at an equitable distribution of property and payment of maintenance for children upon divorce. Although these Acts are supposed to enhance the status of women, the dual legal system (Roman-Dutch law and Customary law) means that a large proportion of women remain affected by the customary law with respect to marriage, inheritance and the custody of children upon divorce.

The government introduced universal primary and secondary education at independence. The level of education in Zimbabwe is one of the highest in Sub-Saharan Africa. Primary education was close to universal for both sexes by the mid-1960s and universality was achieved after 1991. Secondary school enrolment, already relatively high by African standards in the mid-1960s at 5 per cent, has now risen to 40 per cent, the second highest coverage recorded in Sub-Saharan Africa. The disparity between male and female enrolment, though significant (51 versus 35 per cent), is smaller than the African average. Participation in tertiary education, though still low at 5 per cent, is higher than in most African countries. Consequently, the majority of Zimbabweans over the age of 10 years are literate, and the majority of the illiterate population are in the oldest age groups.

Although a family planning programme was established in 1953 in Zimbabwe, it was an uncoordinated venture. Benefits of the programme were more pronounced in the urban areas because activities in rural areas were hindered by the escalating war. At independence, the new government got rid of most of the white workers in the Family Planning Association in an effort to identify it with the people, although it was reported officially that the whites resigned in protest at being integrated with the Ministry of Health. The task of carrying out family planning activities was set back by the inexperience of the black management team. It was recognised that spacing of children was an important aspect of African reproductive behaviour. Thus, the new organisation was renamed the Zimbabwe Child Spacing and Fertility Organisation to give it credibility. Its name was soon changed to Zimbabwe Child Spacing and Family Planning introducing explicit reference to family planning activities. Finally, in 1984, the Zimbabwe National Family Planning Council (ZNFPC) was formed. Under an Act of Parliament (1985), the ZNFPC was charged with co-ordinating family planning information and services, providing child spacing facilities, investigating and treating infertility, implementing primary health care and co-ordinating community development activities related to family planning, conducting research in reproductive health, treating sexually transmitted diseases and promoting family planning.

The ZNFPC works through a network of community-based distributors. Their role is to educate, motivate, provide contraceptives (oral and barrier) and make referrals to hospitals for IUDs and sterilization. The community-based distribution system covers all rural areas and can reach women who would not otherwise visit a clinic. The distributors are locally recruited people, who are known in the community and who know the language and culture of the community. The ZNFPC also provides other services. For example, their clinics provide specialist services and Youth Advisory Services aimed at the young and single.

1.3 Data Sources

A number of data sources are available to assess the demographic situation and trends in Zimbabwe. These include four modern censuses carried out in 1962, 1969, 1982 and 1992; the 1984 Zimbabwe Reproductive and Health Survey (ZRHS); the 1987 Intercensal Demographic Survey (ICDS); and the 1988-89 and 1994 Zimbabwe Demographic and Health Surveys (ZDHS). All these enquiries have included questions that can be used for the direct or indirect estimation of fertility.

This study focuses on the data collected in the 1988-89 and 1994 ZDHS. Detailed maternity histories were collected in both surveys and the design, objectives and implementation of the two surveys was sufficiently similar to allow for the construction of comparable variables. The only major difference between the two surveys is that the 1988-89 survey used the Model B questionnaire for countries with low contraceptive prevalence while the 1994 survey used the Model A questionnaire for high contraceptive prevalence countries. The two questionnaires are similar in content and format, except that the latter collected more detailed information on contraception, including a month-by-month calendar of events related to fertility during the five years from December 1990.

2. FERTILITY LEVELS AND TRENDS

2.0 Introduction

The first aim of this section is to estimate fertility levels from the 1969 Census, 1982 Census, 1984 Zimbabwe Reproductive and Health Survey (ZRHS), 1987 Intercensal Demographic Survey (ICDS), 1988 Zimbabwe Demographic and Health Survey (ZDHS), 1992 Census and

1994 ZDHS. The second aim is to estimate fertility levels for the periods before the 1888-89 and 1994 ZDHS surveys using the birth history information that they collected.

2.1 Current Fertility Data

Current fertility data can be affected by misinterpretation of the reference period both if a question is asked about the date of women's last live birth and if one is asked about the number of births in the last 12 months. Dates of birth may not be known or may be misreported. Moreover, some children may be omitted, especially if they died soon after birth. The direction of the biases caused in estimated fertility levels by such errors are listed in Table 2.1. The extent to which each of these errors influences the overall fertility estimates for Zimbabwe is difficult to ascertain in the absence of raw data. For example, it is difficult to evaluate the effect of non-statement of parity and current fertility, as those who fell in this category have often been assigned to zero during data editing by the Central Statistical Office of Zimbabwe. The presence of such problems in the data has produced an uncertain picture as to fertility levels at different times in Zimbabwe, as is shown in Table 2.2. (The estimates of total fertility from the DHS reports are based on births in the last three years).

Table 2.1 Errors in Current Fertility Data and Direction of Bias

Error Type	Direction of Bias
1. Twins and 2 births omitted	-
2. Age at census not at birth	+/-
3. Last dead birth omitted	-
4. Last 12 months interpreted as this calendar year	-
5. Last 12 months interpreted as last calendar year	+/-
6. Date not stated reported as no birth	-
7. No birth reported as date not stated	+
NET EFFECT	Underreporting

Source : Zaba 1993 Lecture Notes

The total fertility rates give the impression of a fluctuating trend in fertility during the period since 1969. For example, when the TFR of 5.6 for the 1982 census is compared with the ZRHS figure of 6.5, one obtains the impression that fertility rose dramatically during the mid-1980s. Nevertheless, this 1984 estimate is the only one which contradicts the impression of an overall trend towards lower fertility during the period under consideration. The 1984 estimate might reflect a genuine phenomenon or might be an artifact in the data. In particular, while there could

Table 2.2 Current Fertility Estimates from Various Sources

Age Group	1969 Census	1982 Census	1984 ZRHS	1987 ICDS	1988 ZDHS	1992 Census	1994 ZDHS
15-19	0.079	0.091	0.131	0.072	0.091	0.082	0.099
20-24	0.272	0.258	0.289	0.219	0.245	0.218	0.210
25-29	0.304	0.253	0.299	0.237	0.229	0.206	0.194
30-34	0.257	0.225	0.263	0.221	0.193	0.180	0.172
35-39	0.218	0.165	0.220	0.161	0.146	0.145	0.117
40-44	0.145	0.093	0.092	0.088	0.073	0.080	0.052
45-49	0.073	0.038	0.011	0.014	0.026	0.032	0.014
TFR	6.7	5.6	6.5	5.1	5.0	4.7	4.3

Source : CSO 1992, 1994 and Institute for Resource Development 1995

have been a post-war baby boom in the early 1980s, other explanations exist as to why the 1984 estimate might be out of line. First, the 1984 survey has a small sample size (2574 women) and the estimate is likely to be affected by sampling error. Second, it might be that all the other surveys and censuses have consistently underestimated fertility. The CSO (1992) noted ‘the possibility of underestimating the total fertility rate using data from the 1982 and the subsequent surveys cannot be ignored’.

2.2 Lifetime Fertility Data

Information concerning lifetime fertility may be affected by errors such as omission of dead children and the inclusion of non-biological children, such as fostered children or the husband's children from previous marriages. Likely sources of error in lifetime fertility are listed in Table 2.3.

Table 2.3 Errors in Lifetime Fertility Data and Direction of Bias

Error Type	Direction of Bias
1. Dead women omitted	+/-
2. Emigrant women omitted	+/-
3. Immigrant women omitted	+/-
4. Dead or absent children omitted	-
5. Adopted or step children included	+
6. Zero parity reported as not stated	+
7. Not stated reported as zero parity	-
NET EFFECT	Negative (increasing with age)

Source : Zaba 1993 Lecture Notes

Establishing the trend in lifetime fertility in Zimbabwe is difficult as can be seen from Table 2.4. The average parities *(Pi)* from the 1982 Census are lower than those from the 1969 census for all age groups. However, this trend reverses between 1982 and 1984 as the mean parities for 1984 are consistently higher than those for 1982 in all age groups. The censuses and surveys from 1984 onward show a consistent fall in the parities of all age groups except 15-19 years where there is no clear trend.

Table 2.4 Average Parities from Various Sources

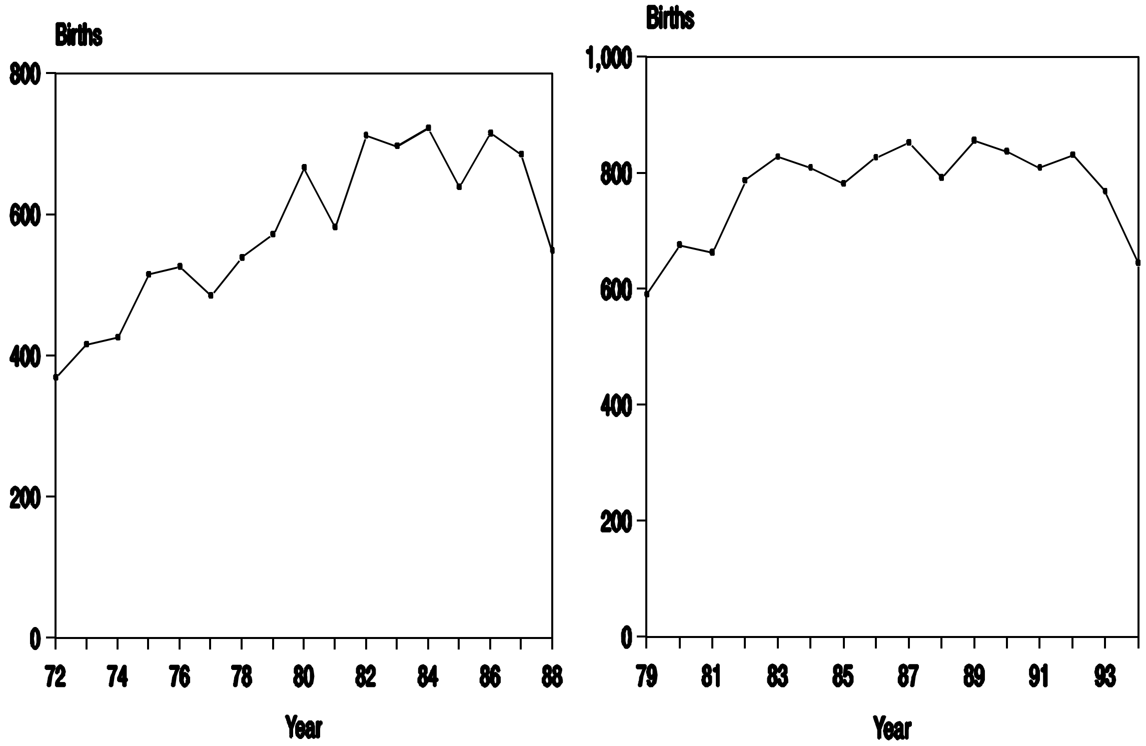
Age Group	1969 Census	1982 Census	1984 ZRHS	1987 ICDS	1988 ZDHS	1992 Census	1994 ZDHS
15-19	0.324	0.185	0.3	0.170	0.188	0.189	0.168
20-24	1.713	1.512	1.6	1.311	1.299	1.119	1.101
25-29	3.372	2.903	3.2	2.983	2.894	2.530	2.364
30-34	4.852	4.175	4.6	4.533	4.346	4.021	3.885
35-39	5.896	5.567	6.2	5.913	5.537	5.278	5.132
40-44	6.549	6.421	7.0	6.770	6.399	6.262	6.071
45-49	6.843	6.639	7.5	7.262	6.869	6.738	6.572

Source : CSO 1992, 1994 and Institute for Resource Development 1995

2.3 Birth History Data

Fertility data collected using maternity histories in surveys, for example, the ZRHS ZDHS I and II are affected by both sampling and non-sampling errors. An evaluation of fertility data from the DHS (Arnold, 1990) revealed errors relating to both the coverage and timing of births. These include systematic displacement of children's birth dates, disproportionate numbers of women's ages heaped at digits ending in 0 and 5, and missing or incomplete information in some birth histories.

Fig 2.1 : Number of Births by Calendar Year Prior to the Survey



The first problem relates to the displacement of births. It is difficult to measure the extent of displacement precisely, but an examination of the year of birth distributions of children helps to identify if displacement is a significant problem. Figure 2.1 shows the annual number of births reported in each year before the two surveys.

A common problem with DHS birth history data is that children born in the last five years have their dates of birth shifted backwards by enumerators so that they can avoid asking a block of subsequent questions relating to children born after this cut-off date (Arnold 1990). Children born in the fifth year prior to the survey are the oldest children included in the health, breastfeeding and family planning sections of the questionnaire. Such an error has implications for examining fertility trends. As noted by Blacker (1994):

> ‘in the DHS type surveys, there is a tendency of displacement of recent births backward in time, thus reducing the number of births recorded for the last five years and inflating the number between 5 and 10 years before the survey, thus simulating a fertility decline. This is further compounded by the fact that every child reported in

less than 5 years entails the asking of a heavy battery of extra questions on feeding practices, immunization, health and anthropometric measurements'.

If births reported in the 1988 survey were transferred incorrectly from the fifth year to the previous year, then a shortage of births should be evident in year 1983 and an excess of births should appear in the previous year. This can be assessed from Figure 2.1. There is not much evidence of shifting of births from 1983 to 1982 in the 1988 survey. Instead, the distribution of births by calendar year in Figure 2.1 shows a slight concentration of births reported for even-numbered years prior to the 1988 ZDHS. This phenomenon is absent in the 1994 survey probably due to improved interviewing techniques which aimed to obtain accurate dates of birth. A minor shortfall of births exists, however, in the year 1988.

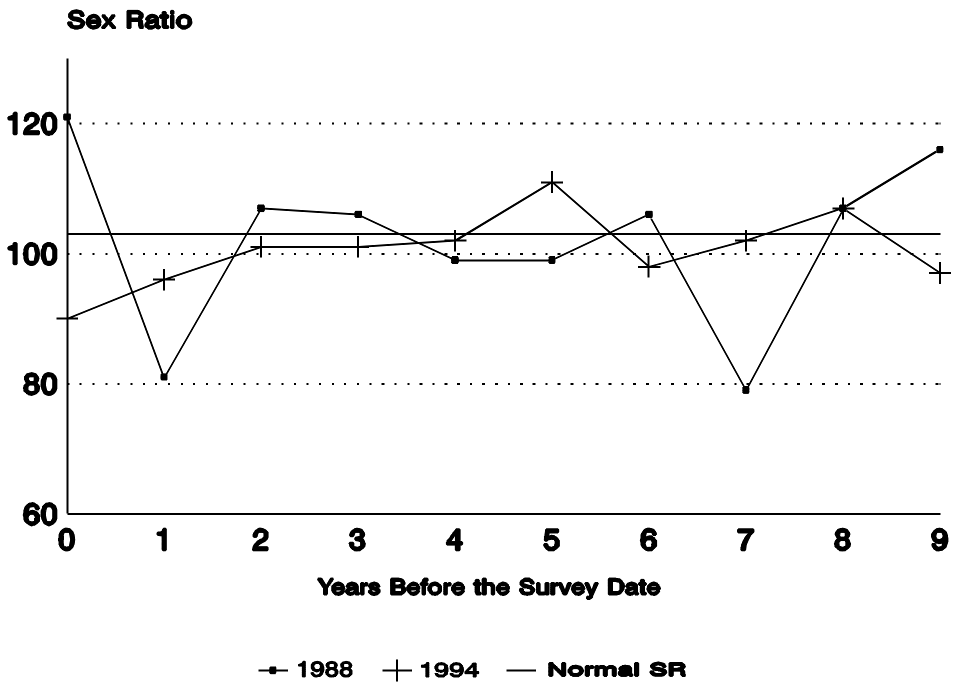
To further investigate shifting of ages of children to avoid asking questions relating to children under five in the first survey, an index of birth displacement has been computed as the ratio of births in the calendar year to half the sum of births in the adjacent calendar years multiplied by 100. Table 2.5 shows the relationship between births in the fifth and sixth years prior to the 1988 survey and the average number of births in the preceding and succeeding years. The value of the birth-year ratios would be approximately 100 in the absence of birth year displacement, heaping on particular years of birth, and erratic annual changes in the total number of births. A small degree of displacement is evident. The problem is greater for dead children than those living.

Table 2.5 Birth Year Ratios by Survival Status of Births

	Centred on Period		Centred on 5 Years Before Survey	
	5 Years	6 Years	Children Dead	Children Surviving
Birth Ratio	97.2	111.3	126.0	95.1

Reported sex ratios at birth that are outside the range usually considered normal could indicate the sex-selective omission of births. Moreover, an examination of the sex ratios at birth for different time periods can reveal changing patterns over time that would suggest the selective omission of either females or males. Sex ratios at birth for five year periods before the survey are shown in Figure 2.2.

Fig 2.2 : Sex Ratios for Periods Before the Survey Date



The trends in sex ratios at birth for the two surveys are erratic, that is, falling below or above the expected value of 1.03. The fluctuations in the 1988 data are more marked. This might be indicative of sex-selective age shifting of births. In neither survey, however, is there a clear time trend in the reported sex ratios.

2.4 Indirect Estimates of Fertility

Considering the uncertainties inherent in the data, it is inevitable that indirect techniques of demographic estimation be used to obtain reliable estimates. The objective of indirect estimation is to take into account the most probable sources of errors and to minimize their influence. This objective is achieved either by making use of demographic models or by making assumptions that translate into clear mathematical relationships. The strength of indirect demographic estimation is that, by basing the analysis on models and plausible hypotheses, the approach introduces some degree of order and consistency into what would otherwise be an amalgam of errors. However, indirect estimation has the weakness that models do not reflect reality precisely and can become sources of error themselves if the underlying assumptions are violated. A number of indirect techniques have been developed in order to adjust for errors prevalent in fertility data from developing countries. Here, the P/F Ratio method and the Relational Gompertz models are used.

2.4.1 The P/F Ratio Method

The P/F ratio method is a procedure for comparing the cumulated fertility of cohorts up to the current age (P) with the corresponding measure, calculated from the period rates for synthetic cohorts (F).

Table 2.6 P/F Ratios, Censuses and single-round surveys

Age Group	1969 Census	1982 Census	1984 ZRHS	1987 ICDS	1988 ZDHS	1992 Census	1994 ZDHS
15-19	1.96	0.95	1.02	1.11	0.96	1.06	0.76
20-24	1.46	1.25	1.07	1.32	1.10	1.06	0.99
25-29	1.26	1.16	1.07	1.37	1.22	1.19	1.11
30-34	1.20	1.13	1.04	1.36	1.27	1.31	1.27
35-39	1.13	1.20	1.10	1.39	1.30	1.36	1.37
40-44	1.09	1.23	1.11	1.40	1.35	1.42	1.47
45-49	1.03	1.19	1.15	1.44	1.38	1.44	1.54

The P/F ratio method can be used to detect fertility trends by examining the behaviour of P/F ratios for older and younger women. If fertility has remained constant over time and there are no reporting errors, then ratios of the mean parities (Pi), and the synthetic mean parities (Fi) would be 1.0 for all age groups. In situations where fertility is changing, lifetime fertility will be different from the level implied by the cumulated age specific fertility rates.

Table 2.7 Adjusted Total Fertility Rates, Censuses and Single-round Survey

Adjustment Factor	1969 Census	1982 Census	1984 ZRHS	1987 ICDS	1988 ZDHS	1992 Census	1994 ZDHS
a. P_2/F_2	9.8	7.0	7.0	6.7	5.5	5.0	4.2
b. P_3/F_3	8.5	6.5	6.9	7.0	6.1	5.6	4.8
c. P_4/F_4	8.1	6.3	6.8	6.9	6.4	6.1	5.4
d. Average b+c	8.3	6.4	6.9	6.9	6.2	5.9	5.1

In all the surveys and censuses the P/F ratios are consistently above one except for the age group 15-19 in 1982, 1988, 1994 and the 20-24 year age group in 1994 (see Table 2.6). This pattern seems to suggest declining fertility as current fertility is persistently lower than lifetime fertility. However, P/F ratios greater than one could also result from the systematic underreporting of births in the reference period, that is the 12 months before the interview date. The magnitude of the P/F ratios in Table 2.6 seems to suggests that both phenomena are present in the data, that is declining fertility and underreporting of current fertility. There is strong evidence of under-reporting of lifetime fertility omission of births in the 1969 census, where the P/F ratios drop with age. The pattern of increasing P/F ratios with age observed in the 1984 and subsequent inquiries represents strong evidence of fertility decline.

Adjusted total fertility rates obtained by applying the P/F ratio method to the different censuses and surveys in Zimbabwe are presented in Table 2.7. Estimated total fertility rates based on four age group combinations are shown. The fertility levels obtained using P_2/F_2 deviate substantially from the other estimates indicating that this adjustment factor is vulnerable to reporting errors. According to Venkatacharya (1989), 'in an analysis of current fertility level in a number of Sub-Saharan English-speaking African countries around 1980, it was found that the P_2/F_2 values were high for many countries and it is only the ratios 25-29 and 30-34 that came close to some reasonable levels'. In this respect, the average of these two age groups is taken as most reliable.

The adjusted estimates show total fertility falling from a high level of above 8 in 1969 to 5.1 in 1994. This represents a fall in fertility of about 39 per cent from 1969 to 1994. However, adjustment of the data in this way yields over-estimates of total fertility if fertility is in decline. Further analysis of the data is required using more robust demographic techniques to separate reference-period errors from trends.

2.4.2 Relational Gompertz Model for CEB and Current Fertility

We use the Relational Gompertz Model to obtain estimates of current fertility (TFR) by fitting a Gompertz function to the reported ASFRs and the average number of children ever born. The ASFRs provide the shape of the fertility distribution and data on average parities give corrected age-specific and total fertility levels. According to Brass (1981), the main advantage of the method is that 'since the fitting averages the current rates, the estimated Fs are less vulnerable to chance and erratic errors in the measures under 25 than with the traditional P_2/F_2 correction'.

This relational model was developed by Brass, who adopted a Gompertz function as a basis for a model of fertility. His aim was to develop a model representing fertility rates by age which could be used with data of dubious quality but requires as few parameters as possible. The model needed to be rigid enough to reveal errors but flexible enough to follow the real distinguishing features of observed fertility. The relational Gompertz model is based on the following equation:

$$Y_A(x) = \text{"} + \$Y_S(x)$$

where *A* denotes the observed population and *S* denotes the standard population, " and $ are constants for a particular fertility distribution and

$$Y(x)=-ln[-ln\{F(x)/F\}]$$

a transformation of *F(x)/F*. *F(x)* is the fertility up to age *x* and *F* is the total fertility rate. The parameters " and $ have clear interpretations. The " parameter changes the age location of the model. If " is 0, the neutral value, then the location is the same as the standard, indicating that about half of the total childbearing occurs by age 27. The $ parameter determines the spread, or degree of concentration of the schedule. Low values indicate a wider spread than in the standard, as might occur in natural fertility populations where marriage is early and childbearing continues into older age groups.

To fit the model in this form requires an independent estimate of current fertility, but in many circumstances the estimates of the TFR are unreliable. A solution was devised by Zaba (1981) through separation of the estimation of the pattern of fertility from the estimation of its level. This is based on the use of the ratios *F(x)/F(x+5)* instead of *F(x)/F*. Zaba (1981) showed that the series of partial fertility ratios *{F(x)/F(x+5)}* or *{P(i)/P(i+1)}* can be represented linearly in the form of:

$$Z(x)-e(x)=\text{"}^{*} + \$g(x)$$

where $ is the same constant as before and "^{*} approximates closely to $\text{"}+0.48(\$-1)^2$. Z(x) is

$$-ln[-ln\{F(x)/(F(x+5)\}]$$

and *e(x)* and *g(x)* are standard values calculated from $F_s(x)$. The advantage is that *F(x)/F(x+5)* does not depend on the total fertility rate but only the shape of the age-specific fertility distribution. Plots of *z(x)-e(x)* against *g(x)* for each survey and census are presented in Appendix A. These plots show that, for all the enquiries, most of the points lie close to the regression line. The exceptions are the final F-point and the last two P-points. The deviation of these points from the regression line is probably due to age-misstatement and the underreporting of parity, respectively. The F-points and P-points selected for fitting the relational Gompertz model are presented in Table 2.8. The measures of goodness of fit of the regression equations used in estimating current fertility are provided in Table 2.9. The standard errors of the fitted P-points are much smaller in 1969 and 1994 relative to the

Table 2.8 Points Used in Fitting the Relational Gompertz Model to Current and Lifetime Fertility

Points\Year		1969	1982	1984	1987	1988	1992	1994
F-POINTS	F_{20}		*			*	*	*
	F_{25}	*	*			*	*	*
	F_{30}	*	*	*	*	*	*	*
	F_{35}	*	*	*	*	*	*	*
	F_{40}		*	*	*			*
	F_{45}							*
P-POINTS	P_{20}		*				*	*
	P_{25}	*	*	*	*	*	*	*
	P_{30}	*	*	*	*	*	*	*
	P_{35}		*	*	*	*	*	*
	P_{40}		*	*	*	*	*	*
	P_{45}							

census/survey years in-between. This could be because in these years (1969 and 1994), the P-values correspond to the fertility schedule (pre- and post-transition respectively) which could have been experienced by a real cohort whereas, in the years in between, the P-values were an amalgam of different fertility histories experienced by different age groups of women that could not represent the experience of one real cohort.

The fitted fertility estimate for 1969 is obtained by using P and F combined while those for subsequent enquiries are obtained by using the separate fit for the F-line as the two lines diverge, suggesting that fertility has been falling. The estimated current fertility measures obtained from the relational Gompertz model are given in Table 2.10. These are obtained by multiplying up by the P-values. The results suggest that fertility was around 7 in the late 1960s and that it fell in the 1970s. However, the downward trend was reversed in the 1980s when the war ended. The downward trend then resumed and has continued in the 1990s. There remain two possible explanations of the high level of fertility in 1984. First it may be an artifact if the *P*-values for 1984 are too high and therefore yield an overestimate of the TFR. Second, it might be a true phenomena if a baby boom occurred in the post-war period but this baby boom was limited to a short period.

Table 2.9 Measures of Goodness of Fit of the Relational Gompertz Model.

Census or Survey Year	R-squared			Standard Error		
	P-Line	F-Line	Combined	P-Line	F-line	Combined
1969	0.991	0.959	0.900	0.029	0.206	0.159
1982	0.987	0.958	0.978	0.131	0.190	0.158
1984	0.952	0.997	0.980	0.133	0.080	0.102
1987	0.988	0.978	0.998	0.212	0.135	0.188
1988	0.971	0.979	0.988	0.200	0.040	0.139
1992	0.990	0.902	0.924	0.102	0.294	0.216
1994	0.911	0.947	0.967	0.007	0.300	0.136

2.5 Reconciliation of Fertility and Population Estimates

The forward projection method can be used to evaluate the fertility and mortality estimates obtained from census and survey data by comparing population forecasts based on them with the observed population recorded in censuses. The objective of these projections is to understand the past rather than to predict the future. The cohort-component method is used applying a sex ratio at birth of 1.03, as there is evidence that the sex ratio at birth is low among populations of African or Negroid origin (UN 1973) and the sex ratio for children ever born in 1994 give an overall estimate of 1.03. Based on the analysis so far, the TFRs adopted for the projection period are:

Year	Unadjusted Rates	Adjusted Rates
1969-74	6.6	7.0
1979-84	5.6	5.9
1989-92	4.8	5.3

Fertility change during the intercensal intervals is assumed to be linear, that is, changes in the TFRs occur at constant absolute amounts each year.

Table 2.10 Current Fertility Estimates Obtained Using the Relational Gompertz Model

Age Group	1969 Census	1982 Census	1984 Survey	1987 Survey	1988 Survey	1992 Census	1994 Survey
15-19	0.131	0.122	0.153	0.111	0.119	0.106	0.110
20-24	0.279	0.271	0.312	0.271	0.262	0.228	0.230
25-29	0.302	0.290	0.320	0.299	0.277	0.252	0.242
30-34	0.278	0.253	0.273	0.261	0.238	0.232	0.210
35-39	0.230	0.192	0.203	0.195	0.178	0.188	0.160
40-44	0.136	0.093	0.098	0.092	0.085	0.100	0.079
45-49	0.028	0.013	0.014	0.012	0.012	0.016	0.011
TFR	6.9	6.2	6.9	6.2	5.8	5.6	5.2
Mean Age	30.1	29.3	29.0	29.4	29.2	29.9	29.2
Standard Deviation	7.7	7.3	7.4	7.2	7.3	7.5	7.4

Scenario 1 : The 1969 census is taken as a base and the population projected forward to 1992. It is assumed that fertility fell during the projection period from the unadjusted rate in 1969 of 6.6, to 5.6 around 1982 and then to 4.8 around 1992. Mortality conditions are assumed to improve such that the life expectancy increased from 47.2 in 1969 to 54.4 in 1984 and then to 56.8 in 1994 for males and from 49.4 in 1969 to 57.8 in 1984 and 60.6 years in 1994 for females. Thus this scenario is based on the unadjusted fertility and mortality schedules for the different time periods and international migration is assumed to be negligible.

Scenario 2 : One hypothesis which is suggested by the analysis so far is that the unadjusted rates underestimate fertility. To take this into consideration, fertility rates are adjusted to reconcile the discrepancies observed in Scenario 1. The mortality assumptions are the same as those used in Scenario 1. After some experimentation the fertility estimates which have been taken as the most plausible are 7 for 1969; 5.9 around 1982; and 5.3 for 1987-92).

Table 2.11a Predictions About Error Effects

Type of Error	Effect on projection	Error Noted in Scenario											
		1->1982		1->1992		2->1982		2->1992		3>1992		4>1992	
		M	F	M	F	M	F	M	F	M	F	M	F
Undercount of children in 1969	Too few 13-17 in 1982	T	T			T	T			na	na	na	na
	Too few 23-27 in 1992			T	T								
Undercount of children in 1982	Too many 0-4 in 1982	T	X			T	X						
	Too few 10-14 in 1992			T	T			X	X				
Undercount of children in 1992	Too many 0-4 in 1992	na	na	X	X	na	na	T	T	X	X	T	T
Fertility too low 1969-82	Too few 0-12 in 1982	X	T			X	X			na	na		
	Too few 10-22 in 1992			T	T			X	X			na	na
Fertility low 1982-92	Too few 0-9 in 1992	na	na	T	T	na	na	X	X				
Mortality too low 1969-82	All ages too high in 82	X	X			X	X			na	na		
	and in 1992			X	T			X	X			na	na
Mortality too low 1982-92	All ages too high in 1992	na	na	X	T	na	na	X	X	T	T	X	X

<u>Scenario 3</u> : This is a comparison of projection of the 1982 population projected forward to 1992 with the 1992 enumerated population. Based on the unadjusted estimates, it is assumed that fertility fell from 5.6 around 1982 to 4.8 in 1987-92. Life expectancy increased from 54.4 in 1982 to 56.8 years in 1992 for males and from 57.8 to 60.6 years for females.

<u>Scenario 4</u> : The mortality assumptions are the same as in Scenario 3. Fertility is assumed to be higher than the unadjusted rates. The TFRs used are 5.9 for 1982 and 5.3 for 1987-92.

The predictions and results of the above scenarios are presented in Tables 2.11a and 2.11b.

Table 2.11b Comparison of Censuses Total Population Using the Projection Method

	Enumerated Pop		Projected Pop		Difference		% Difference	
Age	Males	Females	Males	Females	Males	Females	Males	Females
Panel A : Scenario 1 : 1969 to 1982-Observed Fertility and Mortality Rates								
0-12	1606390	1640765	1644915	1629533	-38525	11232	-2.40	0.68
13-17	446271	454195	378649	394949	67622	59246	15.15	13.04
18+	1689690	1771119	1824476	1822140	-134786	-51021	-7.98	-2.88
Total	3742351	3866079	3848040	3846626	-105689	19453	-2.82	0.50
Panel B : Scenario 1 : 1969 to 1992-Observed Fertility and Mortality Rates								
0-9	1615351	1633726	1532373	1515917	82978	117809	5.14	7.21
10-22	1643910	1701165	1585055	1569660	58855	131505	3.58	7.73
23+	1822477	1994120	1959234	2018739	-136757	-24619	-7.50	-1.23
Total	5083538	5329011	5076652	5104314	6886	224697	0.14	4.22
Panel C : Scenario 2 : 1969 to 1982-Higher Fertility and Observed Mortality Rates								
0-12	1606390	1640765	1684276	1669042	-77886	-28277	-4.85	-1.72
13-17	446271	454195	378647	394951	67624	59244	15.15	13.04
18+	1689690	1771119	1824475	1822140	-134785	-51021	-7.98	-2.88
Total	3742351	3866079	3887398	3886135	-145047	-20056	-3.88	-0.52
Panel D : Scenario 2 : 1969 to 1992-Higher Fertility and Observed Mortality Rates								
0-9	1615351	1633726	1680173	1662107	-64822	-28381	-4.01	-1.74
10-22	1643910	1701165	1722861	1709156	-78951	-7991	-4.80	-0.47
23+	1822477	1994120	1959234	2018739	-136757	-24619	-7.50	-1.23
Total	5083538	5329011	5278521	5304083	-194983	-24928	-3.84	0.47
Panel E : Scenario 3 : 1982 to 1992-Observed Fertility and Mortality Rates								
<10	1615351	1633726	1520755	1504881	94596	128845	5.86	7.89
>10	3468187	3695285	3425025	3585850	43162	109435	1.24	2.96
Total	5083538	5329011	4945781	5090730	137757	238281	2.71	4.47
Panel F : Scenario 4 : 1982 to 1992- Higher Fertility and Observed Mortality Rates								
<10	1615351	1633726	1686423	1668841	-71072	-35115	-4.40	-2.15
>10	3468187	3695285	3425025	3585850	43162	109435	1.24	2.96
Total	5083538	5329011	5111448	5254689	-27910	74322	-0.55	1.39

Comparison of the projections from 1969 and the enumerated population in 1982 in Panel A of Table 11b shows that there are more male children in the projected population than were subsequently enumerated at the end of the 13 years intercensal period. This probably results from underenumeration of young boys in the 1982 census. In contrast, there are more females and males aged 13-17 in the enumerated population than the projected one. This is almost certainly indicative of poor coverage of young children in the 1969 census.

The comparison of the projections from 1969 and the enumerated population in 1992 in Panel B shows that there are more children enumerated than projected by the end of the 23 years intercensal period. Thus the fertility rates used are probably underestimates. The excess number of children aged 10-22 enumerated might indicate that the TFR obtained in 1969 of 6.6 children per woman was lower than the actual rate. Alternatively, the population of females in the reproductive age groups could have been underestimated, giving an underestimate of the births in the intercensal period. However, the first explanation seems more probable.

The use of higher fertility rates in Panel D tends to improve the fit with the 1992 population figures. The projected number of children in 1982 is higher than enumerated (see Panel C), which may mean that the TFR was somewhat below 6 children by 1982 or may reflect under enumeration of children in the census as has been posited for 1969. As these adjusted fertility rates account for the differences in the expected and enumerated census figures, it is likely that fertility rates were underestimated in all the three censuses and the actual rates are 2 to 3 per cent higher than the observed rates.

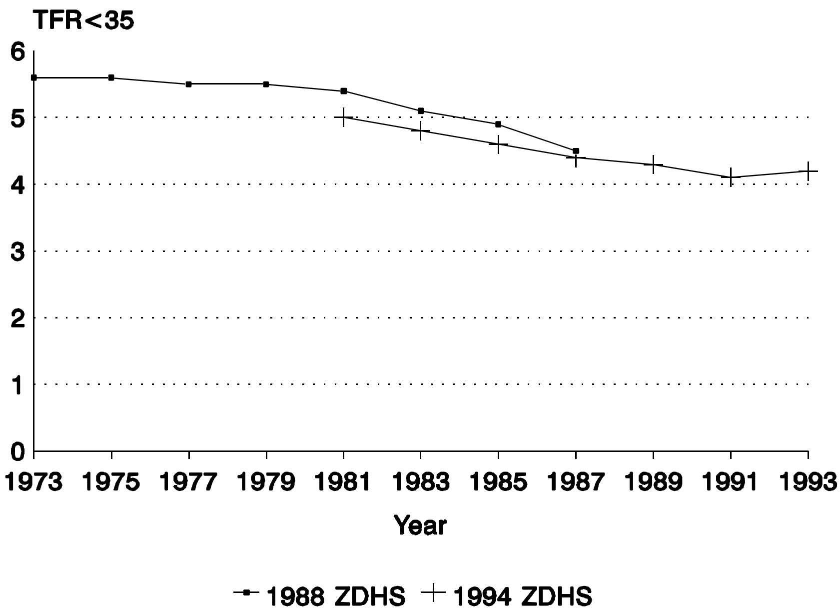
In Panel E, the projected population is less than enumerated population in all cases. This could be a result of better coverage in 1992. The magnitude of the difference is greater for females in all age groups. This could have resulted from poor enumeration in areas where there were security problems especially the two Matabeleland and Masvingo provinces. The difference is largest for the under 10 age group. Since the projections are based on the unadjusted fertility rates in 1982, it is likely that these are underestimates. Panel F shows that the fertility rates during the intercensal period would have to be 5-10 per cent higher to account for the children aged 0-10 years in 1992.

From the projections presented above, it can be concluded that although some coverage errors are present in the data, many of the discrepancies between the censuses and projections based on scenarios 1 and 3 can be attributed to the underestimation of fertility rates throughout the period. The projections provide clear evidence that births in the last year are under-reported in single-round surveys and censuses in Zimbabwe. After correction, the TFR for the period 1987-1992 is about 5.3 which is almost the same as that of 5.4 obtained by the 1988 ZDHS for 0-4 period before the survey. As an aside, it is worth noting that the censuses consistently enumerated fewer boys and more girls than were projected. Thus the sex ratio at birth in Zimbabwe may be as low as 1.00-1.01.

2.6 Trends in Period Fertility from Birth Histories

The birth histories collected in the 1988-89 and 1994 ZDHS provide dates of birth of children. Fertility rates can be calculated from these birth dates for the periods before the survey. As data were collected from women aged 15-49, period fertility rates up to age 35 can be obtained for the 15 years before the survey. In the Zimbabwean case two surveys were conducted approximately 5 years apart. Thus, there is a 10 year overlap and information on this overlap period can be used to cross-check responses from either survey. Period total fertility by age 35 for the years before the surveys is presented in Figure 2.4.

Fig 2.4 : Fertility Cumulated at Age 35 by Year



There is a clear indication of fertility decline from 1973 to 1993. The two surveys indicate a similar trend in fertility though the estimates from the 1994 ZDHS for 1981-88 are slightly lower than those from the 1988-89 survey. Period fertility by age 35 has fallen from 5.6 to 4.2. Fertility also seems to have fallen at older ages as the age-specific fertility rates for 1988 and 1994 shown in Table 2.12 reveal. Although the patterns of change differ for unadjusted and the adjusted ASFRs, it can be seen that there have been substantial declines in all age groups. The Gompertz model fits much better for 1988 than for 1994.

2.7 Fertility by Cohort and Period

Birth histories provide data which can be used to compute cohort and period fertility rates as the three important dates are recorded, that is date of survey, dates of birth of children and date of birth of woman. Cohort-period fertility rates be evaluated using P/F ratios. Moreover, according to Goldman and Hobcraft (1982)

> age-specific fertility rates are difficult to calculate (because of the need to allocate fractions of person- years of exposure of different age groups to different time periods), and if events are allocated by calendar year of exposure of occurrence, one has only partial information and possibly biased information for the calendar year of the survey. Hence, the use of cohort-period specific fertility rates is more appropriate when the data are obtained from fertility surveys with birth histories.

The results of applying the method to the 1988 and 1994 ZDHS are presented in Tables 2.13 and 2.14 respectively. Panel A presents cohort-period fertility rates which are aligned according to the age of the cohort at the end of each time period. They are obtained by dividing the number of births by the product of the number of women in the cohort and the number of years of exposure. Panel B contains the mean parities that cohorts achieved by the end of each period. Panel C shows the mean parities that a synthetic cohort would achieve at different ages if it were to experience the rates observed in a given period. Panel D contains the P/F ratios which are the

Table 2.12 Changes in Age-Specific Fertility Rates Between the 1988 and 1994 ZDHS

Age	0-3 Years Before Survey			Relational Gompertz Model Estimates		
	1988	1994	% Reduction	1988	1994	% Reduction
15-19	0.103	0.099	3.88	0.119	0.110	7.56
20-24	0.247	0.210	14.98	0.262	0.230	12.21
25-29	0.247	0.194	21.46	0.277	0.242	12.64
30-34	0.219	0.172	21.46	0.238	0.210	11.76
35-39	0.160	0.117	26.88	0.178	0.160	10.11
40-44	0.086	0.052	39.53	0.085	0.079	7.06
45-49	0.036	0.014	61.11	0.012	0.011	8.33

Table 2.13 Cohort-Period Fertility Rates, Cumulative Fertility by Cohort and Period and P/F Ratios, 1988 Zimbabwe Demographic and Health Survey

Age Group	Years Prior To the Survey						
	0-4	5-9	10-14	15-19	20-24	25-29	30-34
PANEL A : Cohort-Period Fertility Rates							
15-19	0.038	0.059	0.076	0.072	0.080	0.094	0.103
20-24	0.201	0.252	0.254	0.245	0.234	0.248	
25-29	0.251	0.302	0.301	0.311	0.308		
30-34	0.242	0.278	0.283	0.268			
35-39	0.203	0.226	0.227				
40-44	0.132	0.162					
45-49	0.057						
PANEL B :Cumulative Fertility Rates at End of Period (P)							
15-19	0.188	0.295	0.378	0.360	0.399	0.469	0.517
20-24	1.299	1.641	1.628	1.625	1.638	1.759	
25-29	2.894	3.136	3.129	3.195	3.300		
30-34	4.346	4.522	4.610	4.641			
35-39	5.537	5.739	5.776				
40-44	6.399	6.586					
45-49	6.869						
PANEL C : Cumulative Fertility Within Periods (F)							
15-19	0.188	0.295	0.378	0.360	0.399	0.469	0.517
20-24	1.192	1.557	1.647	1.586	1.569	1.710	
25-29	2.445	3.065	3.151	3.143	3.110		
30-34	3.655	4.457	4.566	4.484			
35-39	4.671	5.586	5.701				
40-44	5.331	6.397					
45-49	5.614						
PANEL D : P/F Ratios							
20-24	1.090	1.053	0.989	1.024	1.045	1.028	
25-29	1.184	1.023	0.993	1.017	1.061		
30-34	1.189	1.014	1.010	1.035			
35-39	1.185	1.027	1.013				
40-44	1.200	1.030					
45-49	1.224						

values of the cell in Panel B divided by the corresponding cell in Panel C.

An examination of Panel A in Table 2.13 suggests that there was a modest decline in fertility largely concentrated in the previous 5 years. Comparing the periods 0-4 and 5-9 years before the survey, the largest decline is noted in the age group 15-19, where the fertility rate has fallen by about 36 per cent. All the other age groups show substantial declines in the same reference period ranging from 10 per cent for age group 40-44 to 20 per cent for age group 20-24. Fertility rates fell by about 37 per cent from the period 25-29 to 0-4 years before the survey for the age group 15-19. In Panel B, there is an indication that there are serious omissions of births by the cohort aged 45-49 years. Fertility decline is further confirmed in Panel C where cumulative fertility by age group has shown changes. For example, cumulative fertility for the age group 30-34 fell from 4.5 for the period 10-14 years before the survey to 3.7 in the period 0-4 years before the survey. In Panel D, the P/F ratios provide supporting evidence of fertility decline in the most recent period (0-4) where the P/F ratios are consistently above one and increase with age. For earlier periods, the P/F ratios are near unity or deviate from one with no clear pattern.

Table 2.14, based on the 1994 ZDHS, provides further evidence of an ongoing decline in fertility. The fertility rates in Panel A show a declining trend during the 10 year period before the survey. Cumulative fertility for each age group in Panel C shows significant changes. For example, cumulative fertility for the age group 30-34 fell from 4.6 for the 10-14 year period to 3.0 in the period 0-4 years before the survey. The P/F ratios for the two most recent periods before the survey are consistently above one and show an increasing trend over the age groups, which is indicative of fertility decline.

Table 2.14 Cohort-Period Fertility Rates, Cumulative Fertility by Cohort and Period and P/ F Ratios, 1994 Zimbabwe Demographic and Health Survey

Age Group	Years Prior To the Survey						
	0-4	5-9	10-14	15-19	20-24	25-29	30-34
PANEL A : Cohort-Period Fertility Rates							
15-19	0.034	0.045	0.073	0.075	0.070	0.066	0.078
20-24	0.176	0.195	0.258	0.244	0.233	0.243	
25-29	0.204	0.256	0.307	0.304	0.302		
30-34	0.187	0.252	0.290	0.276			
35-39	0.153	0.214	0.230				
40-44	0.109	0.149					
45-49	0.037						
PANEL B :Cumulative Fertility Rates at End of Period (F)							
15-19	0.168	0.223	0.366	0.377	0.352	0.329	0.388
20-24	1.101	1.343	1.667	1.573	1.496	1.602	
25-29	2.364	2.948	3.106	3.017	3.113		
30-34	3.885	4.368	4.466	4.494			
35-39	5.132	5.534	5.644				
40-44	6.081	6.388					
45-49	6.572						
PANEL C : Cumulative Fertility Within Periods (F)1.101							
15-19	0.168	0.223	0.366	0.377	0.352	0.329	0.388
20-24	1.046	1.200	1.657	1.597	1.520	1.543	
25-29	2.067	2.481	3.189	3.118	3.031		
30-34	3.004	3.743	4.638	4.499			
35-39	3.768	4.811	5.788				
40-44	4.315	5.555					
45-49	4.499						
PANEL D : P/F Ratios							
20-24	1.052	1.119	1.006	0.985	0.985	1.038	
25-29	1.144	1.188	0.974	0.968	1.027		
30-34	1.293	1.167	0.963	0.999			
35-39	1.362	1.150	0.975				
40-44	1.409	1.150					
45-49	1.461						

Fig 2.5: Fertility Trends by Residence

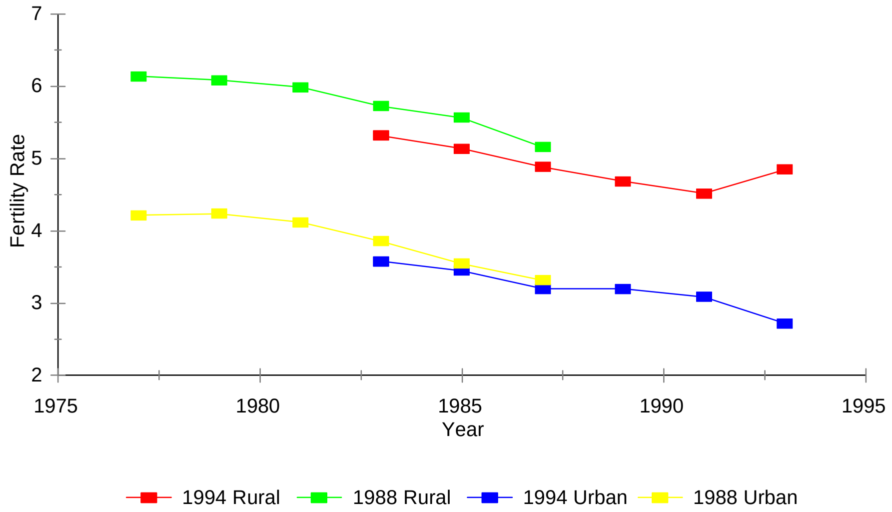


Fig 2.6: Fertility Trends by Region

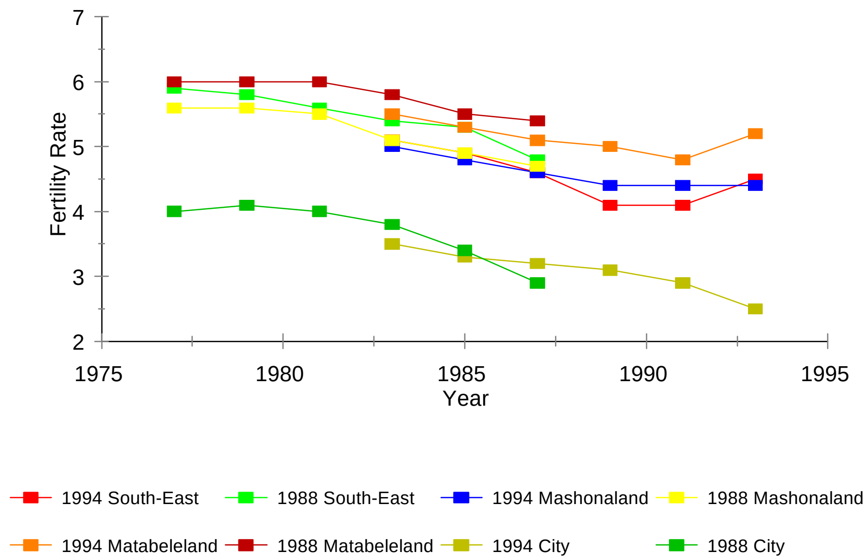


Fig 2.7: Fertility Trends by Education

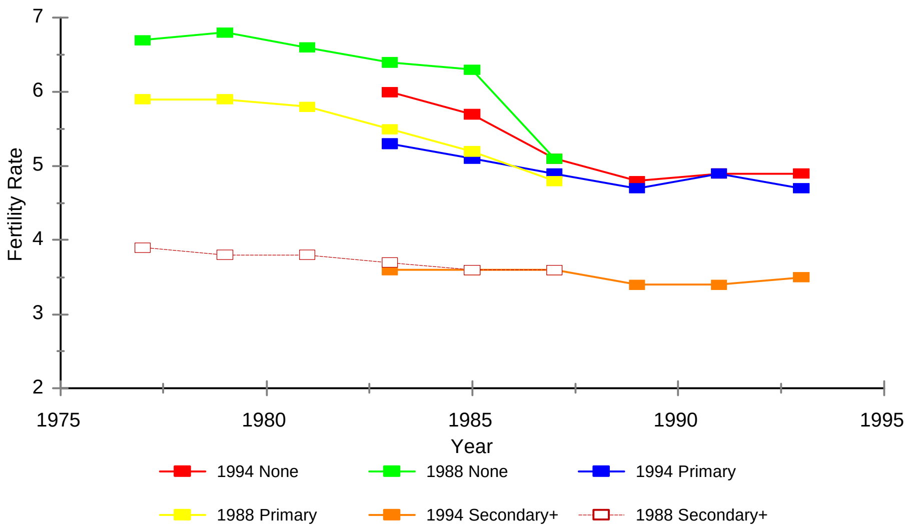
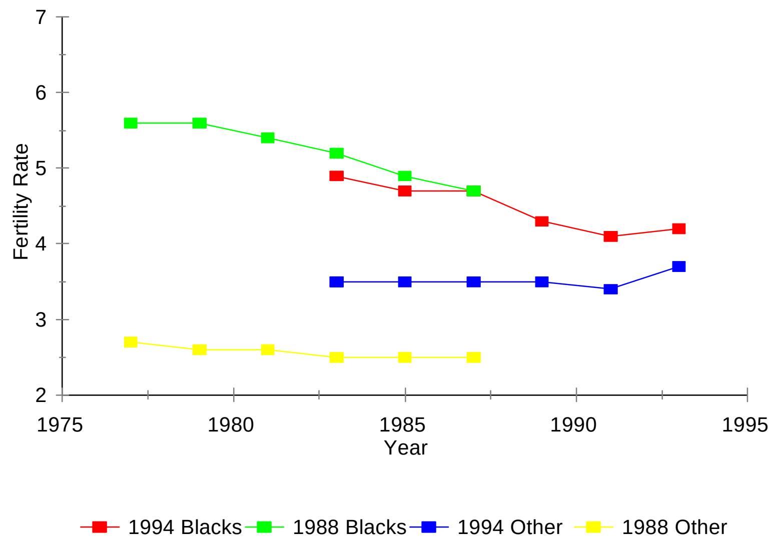


Fig 2.8: Fertility Trends by Ethnicity



2.8 Differential Trends

Theories of fertility decline have emphasized that fertility decline occurs first among the educated and urbanized women and then with time spreads to other sub-groups. There is a need to test the validity of this assertion. This can be achieved by examining differential trends by background variables, that is, education, place of residence, region, ethnicity and religion. The results are presented in Figures 2.5 to 2.8.

Fertility decline has occurred in both rural and urban areas, as shown in Figure 2.5. Fertility has declined by about 15 and 9 per cent in urban and rural areas respectively during the period under consideration. Fertility declined in parallel for the two strata, although the level is consistently higher in rural areas than urban areas. The estimates derived from the two surveys are fairly consistent with each other for the two strata.

Figure 2.6 shows the trend in the fertility of women aged less than 35 by region. Although these regions are administrative in nature, they also reflect differences in socio-economic development, social amenities and ethnicity. The City provinces (Bulawayo and Harare) have the lowest fertility rates throughout the period under consideration. Matabeleland provinces (Matabeleland North and Matabeleland South) show signs of fertility increase in the 1970s, stable and high fertility in the 1980s and a modest decline thereafter. The increasing trend in Matabeleland might be an artefact due to underestimation of fertility as a result of the continuing war after independence. The provinces which experienced the largest declines are the City provinces, where fertility fell by about 37 per cent from 1973 to 1993, followed by South-East provinces (Manicaland, Midlands and Masvingo) with a 23 per cent decline. In Mashonaland (Mashonaland East, Mashonaland West and Mashonaland Central) and Matabeleland, fertility rates have declined by about 21 and 13 per cent respectively.

Education is considered to be one of the most important determinants of fertility decline. Here, maternal education is classified into three categories : no schooling, primary schooling and secondary schooling or higher education. Using this classification captures crucial educational transitions that are related directly to employment prospects and socio-economic status. Trends in fertility by level of education are presented in Figure 2.7. Fertility levels have been consistently low for the women with secondary or higher education. Women with primary education experienced a fertility decline of about 8 per cent during the period under consideration. There are signs of fertility decline in the 1980s among women with no education. This could have resulted from the adoption of family planning services through the use of community-based distributors in rural areas where most of the uneducated women reside. Educational differentials in fertility become narrower with time.

Ethnicity is a major indicator of cultural differences in any society. In Zimbabwe, the major ethnic divisions are: Black and other. The ‘other’ category includes whites, Asians and coloureds. The pattern of fertility decline by ethnic composition is presented in Figure 2.8. Fertility has been falling among the Blacks throughout the period. The pattern of fertility exhibited by the non-black population resembles closely that of Anglophone populations of overseas settlement, for example South Africa and Australia. During the inception of the family planning services, the target clientele were the whites and Asians. While the family planning programme was introduced as far back as 1953, until 1980 these services were used mostly by the whites and Asians, so this group has been exposed for a long period. Fertility differentials between the ethnic groups have narrowed with time. There is a discontinuity in the series for ‘other races’, which is not apparent in any other sub-group of the population. The explanation may be large-scale emigration of whites recently as emigration could have been most pronounced for those with the lowest fertility.

2.9 Discussion

A summary of the estimates of total fertility derived using different methods are presented in Table 2.15. These results show that fertility, as measured by the total fertility rate has been declining in Zimbabwe. Despite the evidence which has been presented of underestimation of fertility in all the censuses and surveys, once these are corrected a clear picture of the trend in fertility still emerges. Total fertility probably declined from approaching 7 to nearer 6 in the 1970s, perhaps due largely to spousal separation and women postponing births during the war period. In the early 1980s, there was probably an increase in fertility as a result of the post-war baby boom. However, a strong family planning programme was introduced in the early 1980s and this had strong impact on the quantum of fertility. It has reduced achieved parities and led to a sustained fall in period fertility.

Table 2.15 Fertility Estimates Using Various Methods

Period	Unadjusted	P/F Ratio	Relational Gompertz	Projections
1969	6.6	8.3	6.9	7.0
1982	5.6	6.4	6.2	5.9
1984	6.5	6.9	6.9	
1987	5.1	6.9	6.2	
1988	5.0	6.2	5.8	
1992	4.8	5.9	5.6	5.3
1994	4.3	5.1	5.2	

The projections indicate clearly that unadjusted data from the surveys and censuses underestimate current total fertility by nearly half a child. The consistency of the retrospective estimates from the 1988 and 1994 ZDHS suggests that this may well also be true of the recent estimate of 4.3 for 1994. Thus, the picture that emerges is that the TFR had indeed fallen by more than two children by 1994 but that throughout the last 25 years the TFR has been about 0.4 of a child higher than the unadjusted estimates suggest. The TFR in 1994 was probably around 4.7 children per woman.

3. PARITY-SPECIFIC ANALYSIS OF FERTILITY DECLINE

3.0 Introduction

Studies of fertility trends need to separate the effects of family size limitation from that of short-term fluctuations. Changes in period rates may be due to a timing change, that is couples advancing or postponing births or real changes in fertility levels, that is couples having smaller families. A rise in women’s ages at the onset of childbearing can have a major, but largely temporary impact on period fertility rates. In this section, trends in the quantum of fertility are studied using parity progression ratios for cohorts who have either completed reproduction or are still in the process of building families. The analysis uses life tables for the analysis of censored birth intervals.

3.1 Completed Family Size

The first method used is to examine progression among women who have, or have almost, completed their childbearing. Parity progression ratios (PPR: the proportion of women going from an n^{th} to an $n+1$ birth) are a sensitive measure of fertility but very robust to data errors such as the misdating of births or confusion between childlessness and failure to report. However, before presenting the PPRs, it important to evaluate the data. An examination of women by proportion in parity *n* and over shows the quality of reporting of children ever born. Assuming there is no differential death and emigration, the proportion in parity *n* and over can only grow with time. So, comparing a cohort from one study to the next allows examination of the quality of data. This is set out in Table 3.1. The data in Columns B, C and

Table 3.1 Tracing Approximate Cohorts of Parity n+ From One Survey To Next

Birth Years	1938-43	1943-48	1942-47	1944-49	1947-52	1949-54
Observation Year	Surv ' 88	Surv '88	Census '92	Surv '88	Census '92	Surv '94
Parity n+	Col A	Col B	Col C	Col D	Col E	Col F
1	0.9655	0.9748	0.9603	0.9880	0.9643	0.9779
2	0.9310	0.9245	0.9315	0.9519	0.9327	0.9447
3	0.8758	0.8742	0.8847	0.9015	0.8811	0.8819
4	0.8276	0.8114	0.8264	0.8462	0.8164	0.8247
5	0.7517	0.7064	0.7536	0.7597	0.7306	0.7528
6	0.6655	0.6227	0.6631	0.6659	0.6207	0.6162
7	0.5517	0.5283	0.5518	0.5505	0.4865	0.4631
8	0.4551	0.4246	0.4304	0.4087	0.3492	0.3063

D and Columns E and F refer to approximately the same cohort at different points in time. One would expect the proportions in parity *n+* in Column C to be higher than in B, and those in Column D to be higher than both B and C and those in F to be higher than E. The ratios that do not conform to these expectations are parity 1 in Column C, parities 7 and 8 in Column D and parities 6, 7 and 8 in Column F. It can be concluded that the 1992 census may have overestimated the proportion of nulliparous women, and the 1994 survey underestimated the proportion at parity 6 and over.

To compute parity progression ratios from a distribution of women by children ever born, the parity distribution is cumulated up from the bottom to obtain the numbers *N(i)* of women with i or more children ever born, *i=0,1,2*....Then the parity progression ratio *p(i)* for the progression from i^{th} to $i+1^{st}$ birth is computed as $N_{(i+1)}/N_{(i)}$. These ratios are presented in Table 3.2.

The progression ratios are high. For example, about 90 per cent of the women who had a fourth birth order moved to birth order five. Progression to higher-order births tends to be lower in the cohorts aged 40-44 at interview than those aged 45-9 but this may be due to the fact that women aged 40-44 are likely to have more births, so the transition proportion will be higher at the end of reproduction. Thus, these data fail to establish whether fertility fell among women born in the 1940s.

Table 3.2 Cohort Parity Progression Ratios (Pn) for Age Groups 40-44 and 45-49

CEB	1988 ZDHS		1992 Census		1994 ZDHS	
	40-44	45-49	40-44	45-49	40-44	45-49
0	0.9748	0.9655	0.9643	0.9603	0.9779	0.9880
1	0.9484	0.9643	0.9672	0.9700	0.9660	0.9635
2	0.9456	0.9407	0.9447	0.9498	0.9336	0.9470
3	0.9281	0.9449	0.9266	0.9341	0.9351	0.9387
4	0.8721	0.9083	0.8949	0.9119	0.9128	0.8977
5	0.8800	0.8853	0.8496	0.8799	0.8186	0.8766
6	0.8485	0.8290	0.7837	0.8322	0.7515	0.8267
7	0.8036	0.8250	0.7179	0.7799	0.6614	0.7424
MCEB	5.9	6.0	5.7	6.0	5.7	6.0

3.2 Parity Progression in Younger Cohorts

In order to investigate recent changes in fertility it is necessary to estimate parity progression for cohorts of women who are still in the reproductive ages. Two problems arise from the incomplete nature of the data, namely censoring and selectivity. Censoring arises from the fact that births to women in the reproductive ages are truncated by the interview, but that does not preclude women from subsequently moving to a higher parity. According to Rodriguez and Hobcraft (1980) ‘censoring denotes essentially the curtailment of exposure by the date of interview, and introduces ambiguity in the definition of the parity progression ratios and the length of the interval. Selectivity refers to the fact that transition from one birth to the next, that is, *i* to *i+1* can only be examined for those women who have reached at least birth *i* at the time of interview. The problem of censoring can be solved by applying life table analysis to births of each order. An important advantage of the life table is that it adjusts the population at risk, that is the number of women of incomplete fertility who have experienced *n* births at different intervals before the survey.

The measure of significance from the life table is the birth function, which is the cumulative proportion of women having a birth of a given order within successive durations since the previous birth. Rodriguez and Hobcraft (1980) propose B_{60} as the key measure, that is the proportion of women who have had a birth within five years of the reference event. The other important measure is the trimean, T, of the birth function normalized at five years. T is given by $T=(q_1+2q_2+q_3)/4$ where q_1, q_2 and q_3 are quartiles defined as the durations by which 25, 50 and 75 per cent of the women who will have a subsequent birth have had it.

3.2.1 Onset of Childbearing

Table 3.3 Proportion Having Made A Transition to First Marriage and First Birth Among All Women

Age	Transition to First Marriage		Transition to First Birth	
	1988	1994	1988	1994
10	0.0034	0.0026	0.0012	0.0000
15	0.1138	0.0754	0.0569	0.0423
20	0.5379	0.5390	0.5012	0.5014
25	0.8379	0.8515	0.8580	0.8596
30	0.9034	0.9366	0.9307	0.9397
35	0.9448	0.9679	0.9755	0.9662
40	0.9655	0.9702	0.9686	0.9730
45	0.9655	0.9779	0.9686	0.9752
50	0.9655	0.9779	0.9686	0.9752
Median	19.55	19.58	19.99	19.98

The cumulative proportions of women having married and had a birth are presented in Table 3.3. The median ages at first marriage and first birth are similar for the two DHS surveys. The median age at first marriage (19.6) is slightly lower than the median age at first birth (20). Both marriage and childbearing start early in Zimbabwe, resulting in women having long exposure to the risk of transiting to high-order parities in the absence of effective methods of family limitation. On average, marriage starts earlier than first births in Zimbabwe. However, defining marriage is problematic in Zimbabwe as it is a process which goes through a number of procedures, so the exact point in time when the marriage occurred might be uncertain. The data from the two surveys indicate that, as age increases, the cumulative proportion married and parous converge. The proportions in the 1994 survey crossover at around age 23 showing that most of those marrying at later ages have had their first birth.

Table 3.4 Cohort-Specific Transition to First Marriage

Age	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Cohort Observed in 1988 ZDHS							
15	0.0372*	0.0667*	0.0972	0.1273	0.0948	0.2013*	0.1310
20		0.5310*	0.6568	0.6978*	0.6207	0.6855	0.6310
25			0.9087	0.9219	0.8944	0.9182	0.8931
30				0.9643	0.9677	0.9560	0.9483
35					0.9806	0.9874	0.9655
40						0.9906	0.9828
45							0.9862
Median		19.67	18.60	18.27	18.85	18.08	18.69
Cohort Observed in 1994 ZDHS							
15	0.0330*	0.0674*	0.0878	0.1062	0.0961	0.0941	0.1010
20		0.5264*	0.5423*	0.6336	0.6426	0.6015	0.6010
25			0.8628	0.8824	0.9309*	0.8616	0.8846
30				0.9509	0.9700	0.9373	0.9591
35					0.9880	0.9886	0.9802
40						0.9705	0.9802
45							0.9904
Median		19.71	19.54	18.73	18.70	19.00	18.99

* Significantly Different from Age Group 45-49 (comparison group) at 5% level

Cohort-specific transitions based on retrospective reporting can provide an indication of changes in ages at first marriage and first birth over time. The cohort-specific transition rates from birth of the women to first marriage are given in Table 3.4. Tests are made on whether other age groups are significantly different from the age group 45-49. A *Z*-test can be computed using the formula:

$$\frac{F(A)\&F(B)}{\sqrt{Var[S(A)]\%Var[S(B)]}}$$

where Var[*S(A)*] is the square of the standard error, *S*, of population subgroup A and Var[*S(B)*] is the square of the standard error of population subgroup B. The test assesses whether *F(A)-F(B)* differs significantly from zero. The data show some small inconsistencies. For example, 69 per cent of 40-44 year old women report being married by age 20 in 1988 but in 1994, only 60 per cent of 45-49 year old women do so, yet this is almost the same cohort. However, these inconsistencies are only found in a few age groups. The cohort-specific transitions to first marriage suggest that the age at first marriage has been increasing over the period. An increase in age at first marriage decreases the period of childbearing in societies where most reproduction occurs within the institution of marriage as in Zimbabwe. Equally, the proportions moving to first marriage by age have been decreasing over time, indicating later transition to first marriage. For example, the proportion of women marrying by age 20 decreased from 63 per cent for the women aged 45-49 to 53 per cent for those aged 20-24 in the 1988 ZDHS. A similar pattern is found in the 1994 ZDHS data. Very early marriage of women below 15 has also been declining. About 13 per cent of the women aged 45-49 were married by the age of 15, but this proportion has decreased to 3 per cent for the 15-19 year old women. In the 1994 ZDHS, the proportion marrying by age 15 has decreased from 10 per cent for the 45-49 cohort to 3 per cent for the 15-19 year old women. The test shows that there is a significant difference in the transition to first marriage between the old cohort (45-49) and the younger cohorts (15-19 and 20-24). Although the middle age groups are not statistically significantly different from the old cohort, evidently age at first marriage has been increasing at a slow pace. The cumulative proportion marrying by age 35 is quite high (about 99 percent) indicating that marriage is almost universal in Zimbabwe. There are no major cohort differences in the proportions moving to first marriage between the two surveys, although the medians for the 1994 survey are slightly higher than for the 1988 ZDHS.

Table 3.5 Cohort-Specific Transition to First Birth

Age	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Cohort Based on 1988 ZDHS							
15	0.0225*	0.0452*	0.0486*	0.0628*	0.0819	0.1164	0.1138
20		0.4893	0.5832	0.5925	0.5280	0.5692	0.5379
25			0.9087*	0.9049*	0.8901	0.8774	0.8379
30				0.9593*	0.9634	0.9403	0.9034
35					0.9763*	0.9717	0.9448
40						0.9748	0.9655
45							0.9655
Median	-	20.17	19.22	19.13	19.69	19.24	19.55
Cohort Based on 1994 ZDHS							
15	0.0128*	0.0276*	0.0560	0.0571	0.0646	0.0572	0.0745
20		0.5012*	0.5390	0.5845	0.5796	0.5498	0.5601
25			0.8836	0.9075	0.9129*	0.8819	0.8774
30				0.9589	0.9670	0.9502	0.9495
35					0.9820	0.9686	0.9832
40						0.9779	0.9856
45							0.9860
Median	-	19.99	19.60	19.20	19.23	19.49	19.38

* Significantly Different from age group 45-49 (comparison group) at 5% level

The earlier ages at first birth, the longer exposure to the risk of having further children. Measurements of transition to first birth are provided in Table 3.5. Ages at first birth changed little between the middle and old cohorts. However, young cohorts show an increase in ages at first birth. While the median age at first birth only seems to have risen by about half a year, the initiation of childbearing by women below the age of 15 years decreased substantially from 11 per cent for women currently aged 45-49 to about 2 per cent for the 15-19 year cohort according to the 1988 ZDHS. There are significant differences by cohort in the proportions having their first birth by ages 15 and 20. No significant differences exist between the 40-44 and 45-49 cohorts at any age.

In birth interval analysis, the first birth interval is defined as the interval from first union to first birth and it is referred to as the protogenic birth interval. Problems exist in the definition and the analysis of the first birth interval. First, the period after marriage is not followed by an insusceptible period following a birth. Second, as Hobcraft and McDonald (1984) point out, “quantum may not encompass sufficient experience where first births occur well after marriage, whether through very early marriage and associated subfecundity or through conscious delay of commencement of childbearing”. Measures of the birth function for the interval from first marriage to first birth are presented in Table 3.6.

Table 3.6 Birth Measures for Progression From First Marriage to First Birth

Birth Measure	Progression Ratio	
	1988	1994
B_1	0.0186	0.0187
B_7	0.1683	0.1730
B_9	0.2658	0.2681
B_{12}	0.5181	0.4705
B_{60}	0.9314	0.9416
Median	12.64	12.54
Trimean	13.13	13.11
Fecundability	0.34	0.28

About 2 per cent of the women have a premarital first birth as measured by B_1. The occurrence of premarital conceptions resulting in marital births as measured by B_7 is 17 percent. In such cases, it is probable that the pregnancy precipitates the marriage. About 27 per cent of women have a first birth within 9 months of marriage and 77 per cent within 2 years. Fecundability as measured on the basis of the experience between 9 and 12 months is high (34 per cent in 1988 and 28 per cent in 1994). This is defined as the proportion of those who had not had a first birth within 9 months of marriage who had their first birth in the next three months.

Table 3.7 Differential Transition From First Marriage to First Birth By Place of Residence

Birth Measure	Urban		Rural	
	1988	1994	1988	1994
B_1	0.0191	0.0158	0.0182	0.0173
B_7	0.1779	0.1714	0.1641	0.1736
B_9	0.2816	0.2677	0.2588	0.2682
B_{12}	0.4693	0.4749	0.4663	0.4690
B_{60}	0.9403	0.9304	0.9274	0.9455
Median	12.61	12.47	12.66	12.56
Trimean	12.91	13.03	13.23	13.13
Fecundability	0.26	0.28	0.28	0.27

Differential transitions from first marriage to first birth by place of residence are presented in Table 3.7. The pattern of transition from first marriage to first birth is not very different for urban and rural areas and between the two surveys.

Table 3.8 Differential Transition From First Marriage to First Birth By Education

Birth Measure	No Education		Primary		Secondary	
	1988	1994	1988	1994	1988	1994
B_1	0.0294	0.0214	0.0155	0.0179	0.0191	0.0127
B_7	0.1774	0.1798	0.1439	0.1627	0.2383	0.1881
B_9	0.2391	0.2410	0.2448	0.2614	0.3574	0.2966
B_{12}	0.4089	0.3950	0.4553	0.4560	0.5589	0.5438
B_{60}	0.8803	0.9099	0.9388	0.9530	0.9546	0.9366
Median	13.80	14.69	12.94	12.75	10.80	11.20
Trimean	14.98	15.37	13.37	13.50	10.98	11.77
Fecundability	0.22	0.20	0.28	0.26	0.31	0.35

Differential in transition from first marriage to first birth by level of education are presented in Table 3.8. Premarital births as measured by B_1 are uncommon, at around 2 per cent for all educational categories. Women with secondary and higher education have the shortest transition median (11 months) from first marriage to first birth. Premarital conceived births as measured by B_7 are highest for women with secondary and higher education (19-24 percent). Women with no education have more premarital births (B_1) than others.

3.2.2 Spacing and Stopping Patterns: Birth Transitions

In this section, transitions between births are considered. The quantums derived from the life table technique can be affected by biases resulting from differential speed of reproduction. In order to eliminate this selection bias, Brass and Juarez (1983) suggest a method which makes comparison between life table estimates (Pn or B_{60}) for pairs of successive age groups with the reports of births in the last 5 years removed from the older age group. The method is based on the concept provided by Ryder (1974) which involves "the elimination of segments of experience for one cohort which are unavailable for another cohort with which it is to be compared". According to Brass and Juarez (1983) in the truncation approach:

> the life table B_{60} values for any given parity transition (say 3 to 4) are calculated and compared for each pair of equivalent cohorts...and trends measured by ratios of B_{60} values of the younger to the old. For the age group 40-44, for example, we calculate a B_{60} value using the complete histories for these women, and for age group 45-49 we calculate a B_{60} value for these women discounting any births occurring within the five years of the survey. The ratio of these two values measures the trend of fertility at any given parity from the 45-49 cohort to the 40-44.

These indices of parity progression from the 1988 and 1994 ZDHS are presented in Table 3.9 and Figure 3.1. The graphs are plotted using the mid-year of each five-year birth cohort. The results in Table 3.9 show that the adjusted B_{60}'s for the oldest age group, 45-49 years, are high at low birth orders and decline for high birth orders. The proportion progressing from first to second birth is 88 per cent and the proportion progressing from seventh to eight about 60 percent. This pattern is similar for all cohorts in both surveys. Cohort differences are also evident. There is a decreasing trend in progression from older to young cohorts. The most important finding is the decrease for younger cohorts in the adjusted B_{60} at low birth orders. At every parity and for almost every cohort pair, the ratios have changed substantially.

Table 3.9 The Proportion of Women Progressing to the Next Birth Within 5 Years

	1/2	2/3	3/4	4/5	5/6	6/7	7/8	8/9
Index of Relative Change 1988 ZDHS								
20-24/25-29t	0.9665	1.0012	0.9067					
25-29/30-34t	0.9908	0.9821	0.9357	0.9122	1.0073			
30-34/35-39t	0.9564	0.9668	0.9669	0.9304	1.0054	1.0176	0.9775	
35-39/40-44t	1.0284	0.9832	0.9784	0.9896	0.9673	0.9306	0.9035	1.0314
40-44/45/49t	0.9803	0.9859	0.9817	1.0146	0.9578	1.0512	1.0006	1.1356
B60 Adjusted 1988 ZDHS								
20-24	0.8112	0.7998	0.6809					
25-29	0.8393	0.7988	0.7504	0.7003				
30-34	0.8471	0.8134	0.8019	0.7676	0.7622	0.7550	0.6765	
35-39	0.8858	0.8413	0.8294	0.8250	0.7581	0.7419	0.6921	0.7803
40-44	0.8613	0.8557	0.8477	0.8337	0.7837	0.7973	0.7660	0.7566
45-49	0.8786	0.8679	0.8635	0.8217	0.8182	0.7585	0.7655	0.6663
Index of Relative Change 1994 ZDHS								
20-24/25-29t	0.9903	0.9343						
25-29/30-34t	0.9035	0.9126	0.9089	0.8664	0.9884			
30-34/35-39t	0.9480	0.9385	0.8580	0.8421	0.9407	0.9872	1.0361	
35-39/40-44t	0.9903	0.9876	0.9701	0.8982	0.9090	0.9235	0.8511	0.9901
40-44/45-49t	0.9878	0.9678	0.9945	1.0257	0.8764	0.9151	0.8765	0.9113
B60 Adjusted 1994 ZDHS								
20-24	0.7368	0.6613	0.7403					
25-29	0.7440	0.7078	0.6437	0.5317				
30-34	0.8235	0.7756	0.7082	0.6137	0.6025	0.6142	0.5475	
35-39	0.8687	0.8265	0.8254	0.7287	0.6405	0.6221	0.5285	0.5418
40-44	0.8772	0.8368	0.8509	0.8113	0.7046	0.6737	0.6209	0.5472
45-49	0.8881	0.8647	0.8556	0.7910	0.8040	0.7362	0.7084	0.6005

Figure 3.1 presents the adjusted B_{60}s from the two surveys for birth cohorts of women. There is a close agreement between the adjusted B_{60}s for equivalent cohorts between the two

surveys at lower parities : 1/2; 2/3; 3/4 and 4/5. At higher-order parities the measures are inconsistent, but both surveys show a declining trend. The pattern of inconsistencies suggest that women exaggerate the intervals between all but their most recent births. This gives a misleading impression of lower B_{60}s in the truncated data than untruncated data for progression ratios which are currently being completed. Thus the most recent adjusted B_{60}s are biased upward. There is no clear trend in progression from eighth to ninth births and this might be a result of small sample size, which causes large sampling errors or because at such high parities the women observed have been highly selected, that is they are faster movers with natural fertility.

The adjusted B_{60}s presented in Table 3.9 can be used further to analyse trends by time period and cohort as this provides a clear indication of whether the changes occurring are cohort linked or period linked. To effectively show the trends, the B_{60} at each time period or cohort is measured according to change from an initial base. Here, the initial base is chosen as the B_{60} for women aged 45-49 at the time of the survey, as these are the oldest women included in the survey. The trends by cohort are provided in Table 3.10 and these show the parity progression of each age group relative to 1000 for women aged 45-49 years.

The table does not show that the reduction in fertility started with a particular cohort at all parities. Instead, the reduction in fertility began at lower parities among younger cohorts. The parity progression ratios show a declining trend from the oldest to the youngest cohorts for all birth orders except 1/2 where the trend is rather erratic in 1988. The declines are occurring at all birth orders except the transition from the 6^{th} to the 7^{th} birth, where no clear trend exists in the first survey. The parity progression ratios are substantially lower for the 1994 ZDHS compared with the 1988 ZDHS at most birth orders.

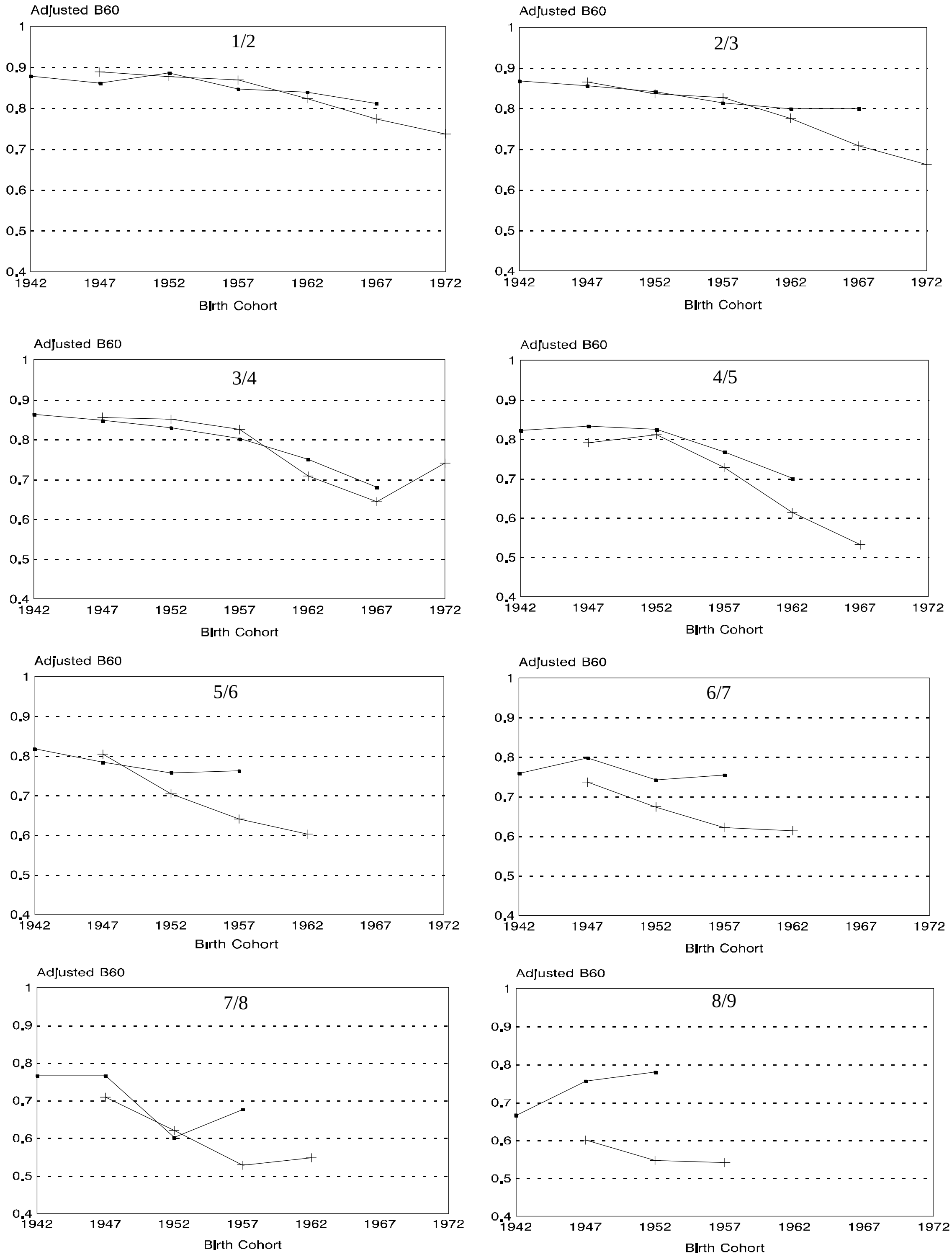


Fig. 3.2: Progression to the next birth within five years by cohort, 1988 and 1994 ZDHS

Table 3.10 Trends in Parity Progression by Cohort

Cohort	1/2	2/3	3/4	4/5	5/6	6/7	7/8	8/9
1988 ZDHS								
20-24	923	922	788					
25-29	955	920	869	832				
30-34	964	937	929	922	832	995	884	
35-39	1008	969	961	936	881	977	904	1171
40-44	980	986	982	971	969	1051	1001	1136
45-49	1000	1000	1000	1000	1000	1000	1000	1000
1994 ZDHS								
20-24	830	765	865					
25-29	838	819	752	672				
30-34	927	897	828	776	749	834	773	
35-39	978	956	965	921	797	845	746	902
40-44	988	968	995	1026	876	915	876	911
45-49	1000	1000	1000	1000	1000	1000	1000	1000

An examination of the trends by period is presented in Table 3.11. The table is constructed from Table 3.10 by organising the measures by diagonals of the age cohort assuming that the mean birth interval is 2.5 years, so the orders move two births back in time for each five years of the age cohort. The measures are obtained by setting 10 years before 1988 and 15 years before 1994 to 1000. The table shows that, while there are some indications of fertility decline in the 1970s, an accelerated reduction in fertility started at the same time for all parities, that is 10 years before the 1988 survey and 15 years before the 1994 survey. In the 1988 ZDHS, a trend in the transition to the second birth and high order births is only clear for 5 years before the survey. The evidence of declines in the progression at all parities since 1982 is equally clear from the second survey. By the middle of the 1980s fertility had fallen by over 5 per cent. During the 15 year period proceeding 1994, progression to fourth and higher-order births fell by about 25 percent.

Table 3.11 Trends in Parity Progression by Time Periods

Birth Order	Years Preceding the Survey										
	0	2½	5	7½	10	12½	15	17½	20	22½	25
1988 ZDHS											
1/2	890	940	991	995	1000	1023	1046	1031	1017	1027	1037
2/3	966	965	974	983	1000	1017	1026	1034	1042	1049	
3/4	905	936	967	983	1000	1011	1022	1032	1041		
4/5	885	926	960	995	1000	1005	998	991			
5/6	973	970	967	984	1000	1022	1044				
6/7	962	954	989	1025	1000	975					
7/8	904	952	1001	1000	1000						
1994 ZDHS											
1/2	877	867	856	902	948	974	1000	1005	1010	1016	1022
2/3	823	851	892	933	963	994	1000	1006	1023	1040	
3/4	756	794	832	901	970	985	1000	1003	1006		
4/5	715	766	838	910	961	1013	1000	987			
5/6	749	773	797	837	876	938	1000				
6/7	818	824	858	892	933	975					
7/8	746	811	876	938	1000						

The results from the truncation approach reveal that there has been substantial fertility reduction at low, as well as middle and higher-order parities, in Zimbabwe. Fertility decline started slowly in the 1970s and accelerated in the early 1980s. The downward trend has been maintained in the early 1990s.

4. CONCLUSION

The preceding analyses have examined a series of measures of fertility using the data available from all national enquiries in Zimbabwe since 1969. The analyses show that, although fertility is still high in Zimbabwe, it has started to fall. The total fertility rate in 1969 was around 7 births per woman while that in 1994 was slightly under 5 births per woman. Ages at first birth and marriage are increasing. Adjusting for truncation bias reveals that parity progression is falling at all birth orders. The reduction in progression to fourth and higher-order births is particularly large but the proportion of women progressing to second and third births has also fallen. Thus, our analysis suggests a different conclusion from those reached by Udjo (1996) and Thomas and Muvandi (1994). For reasons mentioned in the introduction, they believe that fertility decline in Zimbabwe has been slow. The evidence provided in this paper suggests a slow start in the 1970s but then an acceleration of decline in the 1980s. This trend has continued in to the 1990s. We accept that the two ZDHS surveys underestimated current fertility. However, total fertility in Zimbabwe has always been higher than unadjusted data indicate. Because the early censuses also underestimate fertility, in-depth analysis suggests the same conclusion as the calculation of rates from unadjusted data: current fertility in Zimbabwe has dropped by about a third.

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Appendix A : Ratio Method Plots for the Relational Gompertz Model

Figure A.1 Relational Gompertz Model
1969 Census

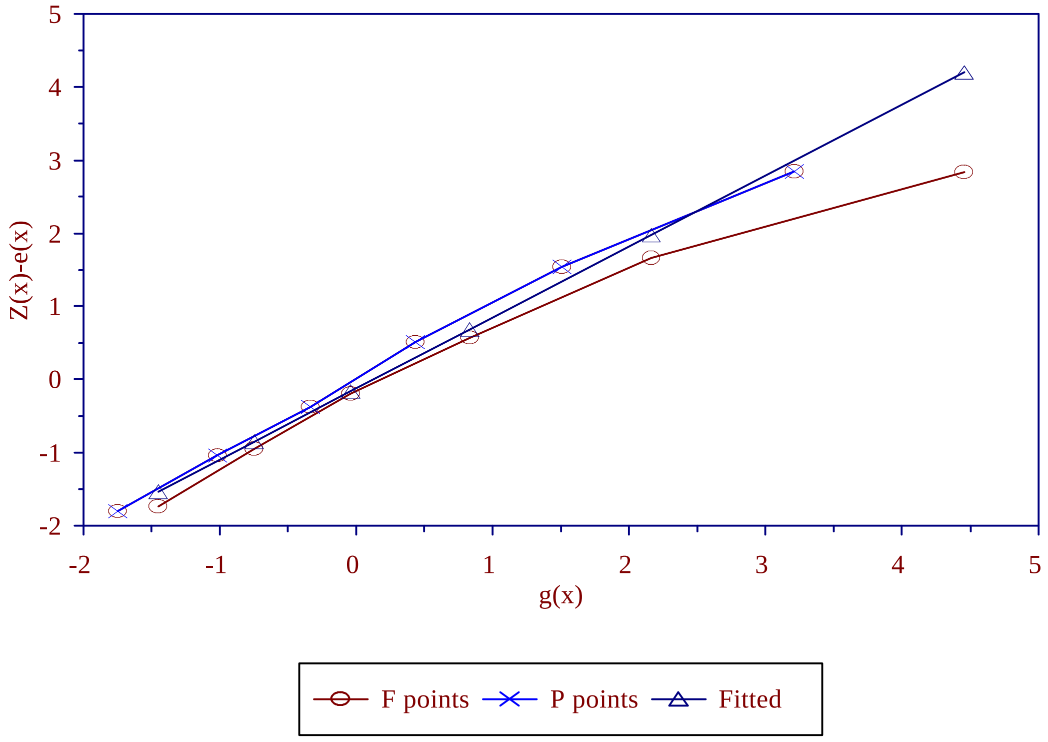

Figure A.2 Relational Gompertz Model
1982 Census

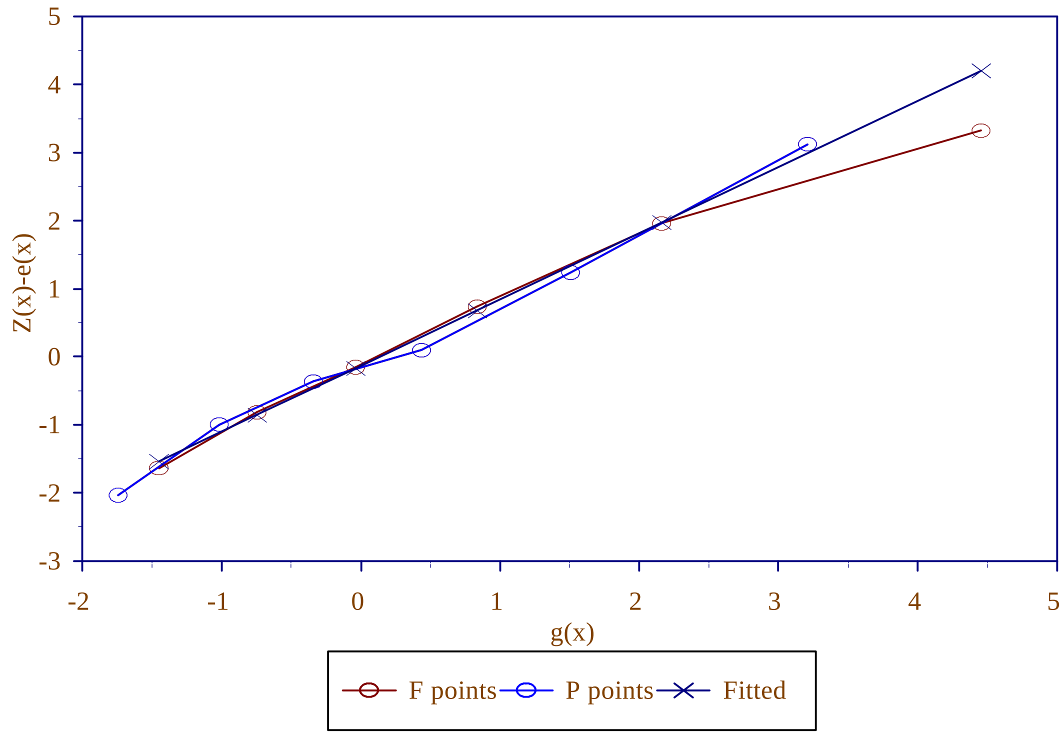

Figure A.3 Relational Gompertz Model
1984 ZRHS

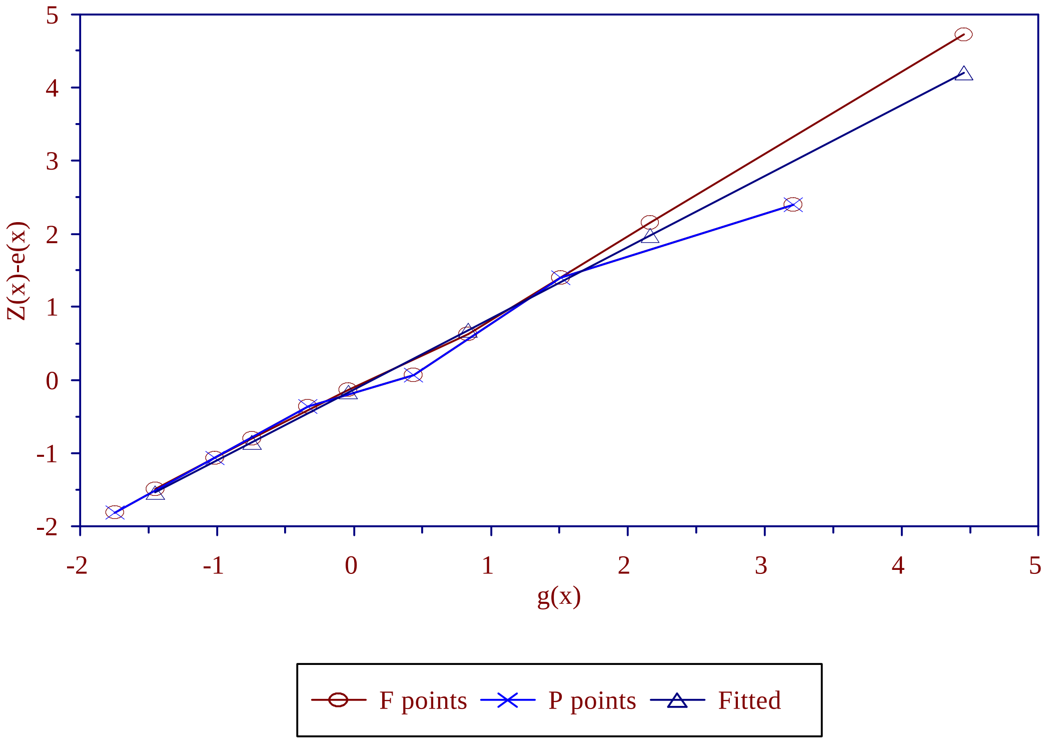

Figure A.4 Relational Gompertz Model
1987 ICDS

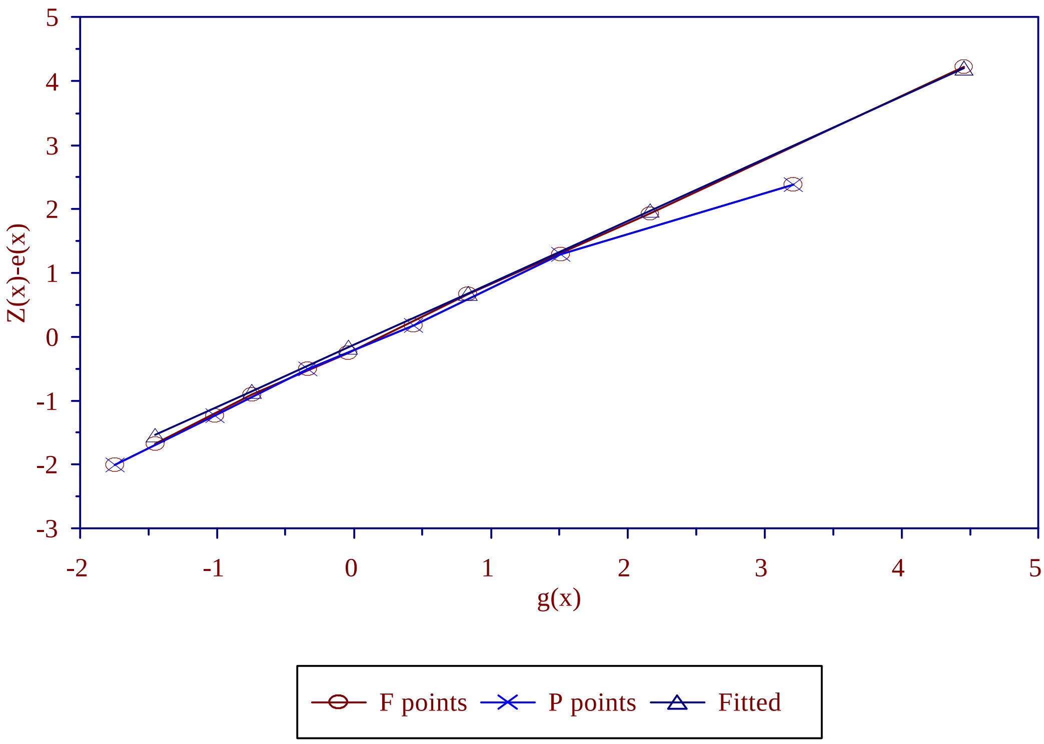

Figure A.5 Relational Gompertz Model
1988 ZDHS

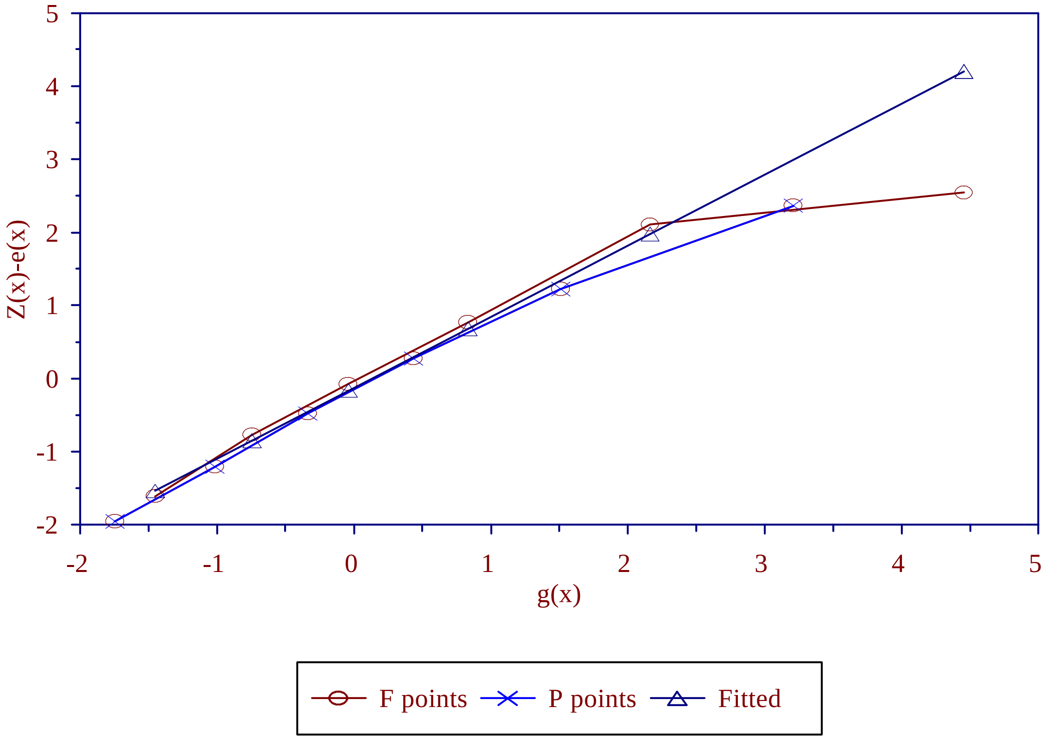

Figure A.6 Relational Gompertz Model
1992 Census

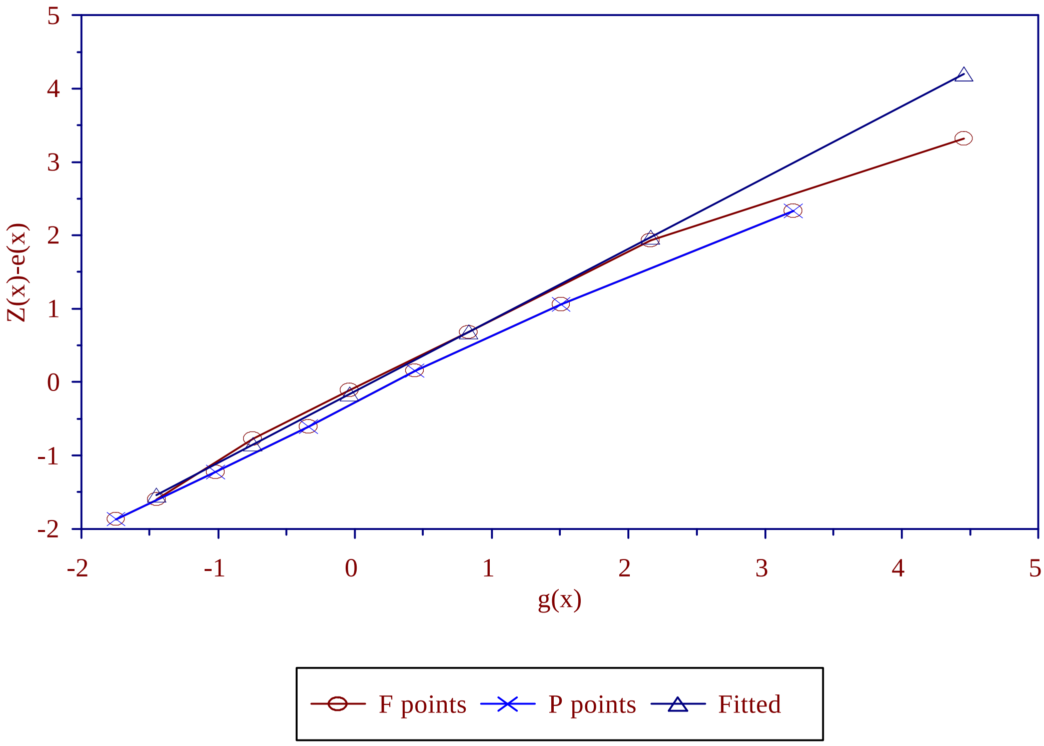

Figure A.7 Relational Gompertz Model
1994 ZDHS