Apartheid's children: Social institutions and birth intervals during the South African fertility decline, 1960-1998

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ABSTRACT

Previous research on the demography of South Africa has not resolved whether the South African fertility decline should be viewed as rapid given the institutional forces ranged against the everyday lives of African South Africans, or as slow, given the country's level of socio-economic development and the vigour with which successive governments implemented family planning programmes.

The thesis presents a detailed demographic analysis of the South African fertility decline. By 1996, fertility among African women had fallen to 3.5 children per woman, not even half the level estimated for 1960. However, projected median birth intervals increased from around 30 months in 1970 to greater than 60 months by the late 1990s.

Using official and historical sources, many of which are in Afrikaans, the thesis argues that the institutional context that prevailed under apartheid is responsible for the slow decline in African fertility and the increase in birth intervals. Birth intervals increased because African women used contraception for neither fertility limitation nor birth spacing as they are conventionally understood. This secular trend towards longer birth intervals is neither parity- nor cohort-specific. African women used modern contraception to postpone childbearing *sine die* as a result of the impositions of apartheid. Hence a third, new, pattern of contraceptive use is identified.

The continued increase in birth intervals after the end of apartheid is not associated with changes in marriage patterns, or social instability caused by internal unrest. Birth intervals have increased most for educated, wealthier and urban women.

Using the South African fertility decline as an example, the thesis argues that the institutional context in which a fertility decline occurs plays an important role in determining the pace of that decline.

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Dad, Kathryn, and Baby Moultrie: Each in your own special way a fragment of South African demography, this is for you.

Tom Moultrie
London, October 2001

1 INTRODUCTION

They said I should
Learn to speak a little bit of English
Maybe practise birth control
Keep away from controversial politics…

(Johnny Clegg and Savuka, "Third World Child")

Apartheid, in all its manifestations, impinged on every aspect of the daily lives of African South Africans[1]. Racial segregation, job reservation, restrictions on mobility, inferior education and health care provision were just some of the more obvious aspects of that system. However, recent histories have argued persuasively that apartheid was not a singular, coherent and hegemonic ideology, but an amalgam of policies forged out of conflict and compromise within the White ruling classes. Consequently, serious internal contradictions existed between different policy arenas.

Demographic concerns were central to many apartheid policies. Hence, it is not surprising that these contradictions impacted both on the formulation of population policy and on demographic outcomes more generally. While official population policies sought to reduce African fertility (driven by White South Africans' fear of being "swamped"), other policies ensured that Africans were systematically denied access to education, health care and urban residence. These factors have been shown to be important in determining the pace of fertility decline in a wide variety of settings in both the developing and developed world.

This contradiction, while identified previously in the literature on the demography of South Africa under apartheid, has not been investigated fully before. Less is known about the historical dynamics of the fertility transition in South Africa than about those in many other sub-Saharan African countries. Government concerns about security and secrecy meant that little of the research into South African demography conducted between 1960 and 1990 by the government and its agencies was published, while the quality of census data collected on the African population was generally poor.

[1] The use of apartheid-era classifications based on population group or skin colour should in no way be taken as condoning that system. However, the unfortunate legacy of apartheid and segregationist policies is such that most demographic outcomes differ in crucial ways according – broadly – to racial categorisations. The term "Black" in this thesis is used to denote all population groups that were historically disadvantaged by apartheid: Africans, Coloureds (people of mixed race) and Indians/Asians. However, in official (i.e. government) literature, the word "Black" usually refers specifically to Africans.

Furthermore, those demographic findings that were made available to the public tended to be published only in Afrikaans.

One consequence of this is that, in their seminal analysis of the South African fertility decline, Caldwell and Caldwell (1993) could not decide whether it should be viewed as being rapid or slow. According to them, the decline could be thought to have occurred relatively rapidly given the institutional forces ranged against African South Africans. On the other hand, they expressed surprise at the slow pace of the decline given the intensity of the family planning programmes implemented by successive governments after 1974, and the level of socio-economic development in South Africa relative to other developing countries. Like the Caldwells, the conclusions to Carol Kaufman's doctoral thesis (Kaufman, 1996) tentatively favour the latter view. Both suggest that the political context in which African women made reproductive decisions may have inhibited a more rapid process of fertility decline. However, neither the Caldwells nor Kaufman attempted to analyse in any detail the possible reasons for this.

Thus, one of this thesis' principal aims is to investigate the extent to which the contradictions between population policy and polity mediated the South African fertility decline, and therefore are responsible to any degree for that slow pace of fertility change. In so doing, our knowledge and understanding of fertility change in South Africa over the last half-century is greatly expanded. Starting with the tentative conclusions reached by the Caldwells and Kaufman about the pace of the fertility decline in South Africa, the overall aim of the thesis is to answer the question: Why has fertility in South Africa declined so slowly?

Three investigations, with different analytical and theoretical approaches, are employed to answer that question. The objective of the first is to redress the paucity of current and historical demographic evidence relating to the past trajectory of the South African fertility decline. Using data from two censuses, Chapter 3 derives more robust and verifiable estimates of the level of fertility among African women between 1960 and 1998 than have been presented before. Similarly, better estimates of current levels of fertility in the country are calculated after a thorough and careful review of recent census and demographic survey data. These data, and their comparison with the trends in fertility in other sub-Saharan African countries, confirm the slow pace of the South African fertility decline.

Chapter 4 uses the results from the 1998 South Africa DHS and an earlier national demographic survey conducted between 1987 and 1989 to derive estimates of changes in parity progression and women's birth intervals. The derivation of median birth intervals is unprecedented in the context of South African demography. With the sole exception of the results from a set of investigations conducted by the government in major metropolitan areas of the country in the late 1960s, investigations into birth intervals in South Africa have not been conducted before. A possibly unique pattern of childbearing among African South African women has therefore remained unnoticed until now.

The objective of the second investigation, presented in Chapters 5 and 6, is to situate the results derived in the two preceding chapters in the broader social and political context of apartheid discourse on population matters. In and of themselves, the results derived in Chapters 3 and 4 are curious, and largely inexplicable. Chapter 5 presents a history of the evolution of population policies in South Africa. It accesses sources that until recently were not available, as well as documents published only in Afrikaans. This chapter argues that the population policies adopted by successive apartheid governments reflected a syncretism between internationally dominant demographic paradigms and the particular needs of the apartheid polity. Chapter 6 develops this analysis by examining the institutional consequences of the apartheid regime's policies for African women's childbearing. It argues that the particular pattern of fertility, childbearing and child spacing observed in South Africa is a logical, rational and coherent response to the institutional conditions under which African South Africans were forced to live their lives.

The theoretical approach adopted in Chapter 6 is based on the ideas of Geoffrey McNicoll. His theorisations on the relationships between societal forces and individual demographic outcomes are integrated with Giddensian social theory and applied to the specific case of the South African polity over the years since 1948. As such, this aspect of the thesis represents a contribution to the growing field of "institutional demography" – an approach to the discipline that seeks to extricate the analysis of demographic processes from the realm of the individual, and to situate them firmly within broader institutional contexts.

An anomaly arises from these two investigations. Chapter 4 shows that median birth intervals in South Africa increased dramatically between 1970 and 1990, and continued to increase after the end of apartheid in the early 1990s. The material presented in Chapters 5 and 6, however, argues that the slow pace of fertility decline and the increase in birth intervals was the consequence of the social and institutional context of childbearing in South Africa under apartheid. Thus, a third set of investigations are undertaken with the objective of discriminating between different possible reasons for the continued increase in birth intervals in South Africa between the mid-1980s and the late 1990s. To achieve this, Chapter 7 takes a more rigorously statistical approach to the modelling and analysis of birth intervals in South Africa. A statistical approach to the measurement and modelling of changes in birth intervals in South Africa using two data sets is proposed and evaluated. Hypotheses relating to the continued increase in birth intervals in South Africa after the end of apartheid are formulated, and conclusions are drawn from the fitted models.

The final chapter synthesises the results from the three investigations into an account of the South African fertility decline that provides an answer to the research question. Conclusions are drawn about the nature of the South African fertility decline. The limitations of the thesis and possible future avenues for research on fertility in South Africa are discussed.

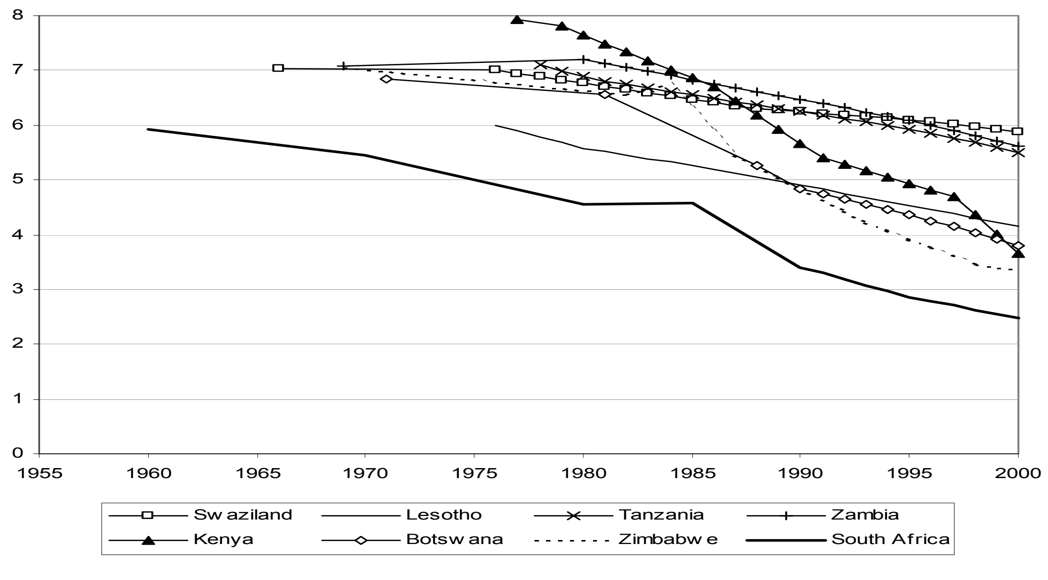
2 FERTILITY AND BIRTH SPACING IN SUB-SAHARAN AFRICA AND THE INSTITUTIONAL ANALYSIS OF FERTILITY: A LITERATURE REVIEW

This review establishes the background to, and the theoretical framework for, the thesis. It covers four areas: the pattern of fertility decline in sub-Saharan Africa; the (rather limited) literature on the South African fertility decline; what is known about the length of birth intervals in South Africa and elsewhere in sub-Saharan Africa; and the relationship between institutions and fertility outcomes. This final part of the discussion pays particular attention to sociological concerns with structure and agency and establishes a theoretical position that informs the rest of the thesis.

2.1 The fertility transition in sub-Saharan Africa

With the singular exception of South Africa, the fertility transition in sub-Saharan Africa only began in the 1980s.

Figure 2.1 Trends in fertility 1960-2000, selected African countries



Source: US Bureau of the Census (2001)

Note: The inclusion of White South Africans in the data presented for South Africa reduces the reported level of fertility but does not affect the overall trend in South African fertility to any undue degree. Fertility among White South Africans has been close to replacement level since the mid-1970s, but they have always comprised a small proportion (less than a fifth) of the population.

Figure 2.1 shows that fertility elsewhere in Southern and East Africa remained resolutely high from 1960 to 1980, while South Africa was experiencing a long and gradual decline in fertility. Since 1980, however, the level of fertility has fallen faster in some of those countries than in South Africa. Over the 20 years between 1980 and 2000, fertility in Kenya fell more rapidly than in South Africa (albeit from a higher base). The pace of fertility decline in both Kenya and Zimbabwe has outstripped that of the decline in South Africa since 1990. Thus, Figure 2.1 offers *prima facie* evidence that the process of fertility decline in South Africa is, in many respects, different to that elsewhere in sub-Saharan Africa, having commenced earlier but progressing more slowly than that in many other countries in the region.

Furthermore, until the decline in fertility in a few African countries (Lesotho, Botswana, Zimbabwe and Kenya in particular) became evident in the late 1980s, the literature on fertility in sub-Saharan Africa concentrated predominantly on the social, cultural and historical impediments to fertility decline. Much of this work drew on anthropological accounts and classifications of social and cultural aspects of kinship systems in the region, and of fertility inhibiting practices such as social proscriptions relating to the duration of postpartum abstinence and breastfeeding. Hence, according to Lesthaeghe,

> the central feature of reproduction in sub-Saharan Africa has been its reliance on a pattern of child-spacing operating through prolonged breast-feeding, or more accurately, through prolonged lactational amenorrhoea in combination with postpartum abstinence. (Lesthaeghe, 1984:9)

In this, and subsequent work, Lesthaeghe identified a number of cultural patterns that maintained the reproductive systems observed in anthropological studies. In addition to those mentioned above, Lesthaeghe and his co-researchers argued that high levels of sterility, the polygynous structure of many African societies, and religious practices and proscriptions kept fertility high through their effect on the duration of postpartum abstinence (Lesthaeghe and Eelens, 1985).

Lesthaeghe and others argue that these factors were self-reinforcing insofar as lengthy prescribed durations of postpartum abstinence served to maintain particular patterns of social organisation, dominance and kinship systems. Building on this work, and that of Schoenmaeckers, Shah, Lesthaeghe *et al.* (1981), they argued that strongly ritualised cultural forms and practices prevented and impeded change in childbearing practices in many parts of sub-Saharan Africa.

Caldwell, Orubuloye and Caldwell (1992) suggest four props that served to maintain high levels of fertility in the region. The first, they argue, was the importance of ancestry and descent in many African societies, which acted as a spur to higher fertility: "high fertility was morally correct, and that childlessness or rearing few children was evil" (Caldwell, Orubuloye and Caldwell, 1992:214). Thus, according to this argument, both abortion and contraception were anathema in many African societies. Second, they argue that social systems in West and Middle Africa incorporating polygyny and child fostering meant that men and women had separate budgets, with women being expected to bear the costs of raising and feeding children, while men were able to extract value from children in the form of labour. Given the predominance of patriarchal societies in the region, the resultant bifurcation of costs associated with childbearing also served to exert upward pressure on fertility. Associated with this, the third prop was the productive systems that prevailed in sub-Saharan Africa. These systems also mitigated towards higher fertility, since systems of land tenure and cultivation required large amounts of labour. Finally, they suggest that structural issues associated with the African state attenuated and limited the efficacy of government population and family planning programmes.

Non-demographers, too, directed attention to the role played by the state and the significance of institutional and cultural factors in advancing or impeding the fertility transition in the region. While some demographers have operationalised these factors in an attempt to model the institutional and cultural correlates of high fertility in the region (see, particularly, Lesthaeghe and Surkyn (1988)), researchers from other disciplines have adopted historiographical and economic approaches to understanding the impact of these factors. One such example is the work of Morag Bell, which argues that political and economic considerations are also important in shaping our understanding of fertility regimes in sub-Saharan Africa:

> a complex network of biological, socio-economic and institutional factors influence fertility and underlying these is culture. The effects of Africa's political, economic and social transformation on fertility is mediated through fundamental cultural norms and values relating to parenthood, family size and child rearing. It is the way in which these cultural beliefs and practices alter over space and time within the broader politico-economic context which influence the character of fertility patterns. (Bell, 1986:151-2)

The work of Lesthaeghe and his collaborators, the Caldwells and others help explain the historically high levels of fertility in sub-Saharan African societies. However, as Figure 2.1 suggests, this research may be of limited applicability to the South African fertility decline. Nevertheless, both Bell and Lesthaeghe suggest (albeit in slightly different ways) that if the institutional structure of societies is of importance in determining fertility levels, then we must look to changes in institutional formations to make sense of the process of fertility decline.

Cohen (1993) uses the results from the Demographic and Health Surveys conducted in many African countries in the 1980s to investigate cross-national fertility dynamics in sub-Saharan Africa. His analysis identifies South Africa as an anomaly in the region, not only because of the relatively low fertility reported, but also because contraceptive use was much higher than in other sub-Saharan African countries. However, he issued a caveat about whether or not South Africa should be viewed as *sui generis*, and not entirely 'African', stating that "there will probably be a great deal of debate about the extent to which comparisons should be drawn between the South African experience and the experiences of other countries in the region" (Cohen, 1993:24). The resolution of this debate is an important component of the thesis, and is addressed in subsequent chapters. The next section examines the literature on the South African fertility decline.

2.2 Literature on South African fertility

In the same year that Cohen expressed uncertainty about the comparability of South African demographic data with that from other sub-Saharan African countries, John and Pat Caldwell (Caldwell and Caldwell, 1993) introduced a journal article with the observation that "South Africa has remained a little-known area on the demographic map of Africa". There are two principal reasons why South African demography has been (and remains) so under-examined.

First, South African demography was hampered for most of the last century by inadequate census, vital registration and survey data relating to the African population. According to Mostert, van Tonder and Hofmeyr (1987:3*)[1], "the census coverage of the African population in the 1904, 1911 and 1921 censuses is regarded as being poor in all respects, the 1936 and 1970 censuses as reasonably good, and those of 1946, 1951, 1960

[1] Throughout this chapter, an asterisk in the citation indicates that I have translated the quoted text from the original Afrikaans.

and 1980 again as less good". The granting of 'independence' to the TBVC states[2] between 1976 and 1981 further exacerbated the difficulties of census data collection in the country. In 1980, the three then-independent states conducted their own censuses, while five separate censuses were conducted in 1985 and 1990.

Questions on African fertility (the number of births in the last year and deaths of children under the age of 1 in the last year) were introduced in the 1960 census, and included again in the 1970 census. A further question on children ever borne was asked in the 1980 census. While "usable" age-specific fertility rates were derived from the 1960 data, the results from the 1970 census "could not have given a true representation of reality," and those from the 1980 census were so bad as to be "completely and utterly unusable" (Mostert, van Tonder and Hofmeyr, 1987:4-5*). Thus, while many African countries began to collect useful data on fertility in their post-independence censuses, in South Africa the calculation of age-specific fertility rates directly from census data was impossible for the entire period from 1960 to 1996.

Though the quality of census data on the African population was poor, the apartheid state's vital registration system for Africans was possibly worse. As late as 1985, vital statistics for Africans were described as a "black hole" (Botha and Bradshaw, 1985), with serious gaps in the reporting of both births and deaths. The system of balkanised registration, split between the 'White' areas of the country, and the so-called 'homelands', meant that probably less than half of Africans' deaths were recorded officially (Dorrington, Bradshaw and Wegner, 1999). In theory, the registration of births should have been more complete, since all children require a birth certificate (and hence registration of birth) to enrol at school. Even with this requirement, a significant proportion of those births that are registered, are registered up to 10 years after they occur. According to Statistics South Africa (2001), of the 680 164 births occurring in 1991 that have been registered (approximately half the estimate of actual births), 42.4 percent were registered in 1991 or 1992, while fully 15.3 percent were registered in 1999 or 2000. Births occurring in earlier years show similar patterns of late and under-reporting.

South Africa's international isolation meant that it was excluded from the scope of the World Fertility Survey in the 1970s and the first rounds of the Demographic and Health Surveys programme. Despite this, large-scale household survey investigations

[2] Transkei, Bophuthatswana, Venda and Ciskei.

into the fertility of African South Africans were undertaken periodically in the 1970s and 1980s by the Human Sciences Research Council (HSRC), the government's official social science research body. An account of these surveys is given in van Zyl (1994). The most important of them were the 1974 investigation into fertility and family planning among Africans (Lötter and van Tonder, 1976), the 1982 WFS-type fertility survey (van Tonder, 1985), and the survey conducted between 1987 and 1989 using a questionnaire similar to that developed for the early rounds of the DHS (Mostert and Lötter, 1990). For reasons discussed later, however, the results of these surveys and studies were not disseminated widely.

The second reason for the limited research on South African demography is that apartheid policies and practices politicised demographic research and its findings more than in most other countries. As Mostert, van Tonder and Hofmeyr (three leading South African demographers) have noted, the Afrikaans term for demography, prior to the widespread adoption of the anglicism *demografie,* was *politiese wiskunde* ('political arithmetic'), a term that neatly encapsulates the reflexive relationship that has existed between population and polity in the country[3]. Mostert, van Tonder and Hofmeyr acknowledge the importance of this nexus:

> The political arena in South Africa is, to a large extent, dominated by the 'arithmetic' of the local population structure, while political decisions have, over the years, exerted a great influence on population trends… In the discussion of demographic trends in South Africa, 'political arithmetic' in this country will of necessity occupy a prominent place. (1988:59)

It is on this "prominent place" afforded to the discussion of "political arithmetic" in the context of the apartheid state and the social, political and economic institutions that it engendered that this thesis concentrates. As is argued in detail in Chapter 5, the fear of Whites being "swamped" and the perceived need to limit African fertility were central to the evolution and rhetoric of apartheid policies. In addition, though, demographic data were regarded as being highly politically sensitive, resulting in a situation where demographic data collected on behalf of the South African government by the HSRC were not made generally available to researchers. The reports based on these surveys and studies were frequently published only in Afrikaans, thereby further

[3] The term itself is not unique to South Africa, and was in common use in Europe in the eighteenth century. However, the overtly politicised connotations of the term are of heightened relevance in South Africa.

restricting their accessibility to outsiders. These documents, though sadly usually not the underlying data, are now available to the public through the HSRC library. Thus, a valuable resource has been opened up to researchers fluent in Afrikaans.

Further, demography was absent from the teaching programmes of the English-medium universities. In part, this reflected the ideologically tainted nature of South African demography and the paucity of data. The effect was to focus research emerging from these institutions not on South African demography *per se* (although some demographic research was done by individuals), but on sociological and anthropological contextualisations of demographic processes, as exemplified by the work of Preston-Whyte (1978, 1988, 1994) and van der Vliet (1991).

As a result, critical analyses of South African demographic data were rare until the early 1990s. One landmark investigation was that into the changing patterns of African culture, social and family structure and livelihoods arising from a study in the Eastern Cape in the 1950s conducted by Pauw (1963). This was among the first investigations to identify the rise of female-headed households in urban South Africa. Pauw's work is also of importance because it was one of the few early investigations into the demography and sociology of the South African population to collect and analyse its own data. Most other articles and critiques relied extensively on government figures quoted in the press, or on statistics published in the South African Institute of Race Relations' Annual Yearbooks.

Thus, few demographers outside of the HSRC (and even fewer academics in other disciplines) wrote on South African fertility until the early 1990s, and those that then began to had to make do with unverifiable published statistics. As a consequence, what research was published tended to be derivative, insofar as demographers were unable to appraise or manipulate data themselves, and hence were forced to focus instead on presenting syntheses, summaries and alternative interpretations of what published data were available. Examples of this literature include Lucas (1992), Caldwell and Caldwell (1993), and Chimere-Dan (1993a, 1993b, 1994). In addition, some of these researchers were unfamiliar with the details of the political, social and economic history of South Africa, and frequently had to rely on the HSRC for assistance in translating and gaining access to government documents. This could, and frequently did, lead to erroneous interpretations of, and conclusions about, the level of South African fertility and the pace of the South African fertility decline.

While a huge literature exists on the politics, practice, economics and social implications of apartheid, a literature on the centrality of demographic concerns to the formulation of apartheid policies does not. Anthropological and sociological critiques of the implications of apartheid population policies, too, remained rare in the years before 1980. The earliest published research detailing the nature and evolution of population policies in South Africa is that of Madi Gray (1980) and Barbara Brown (1987). Both identified the need to locate apartheid population policies in the broader context of the South African political economy, but neither Gray nor Brown accessed material written in Afrikaans or indeed much "official" data at all. To compound matters, these authors lacked the requisite demographic expertise to assess the data critically.

Much of the historical, political and economic literature on apartheid that seeks to engage with aspects of South African demography also suffers from this problem. Hilda Bernstein's otherwise powerful insights (Bernstein, 1975) into the burden borne by African women under apartheid, for example, are undermined by her inability to apply basic demographic techniques to South African census data. She draws exaggerated conclusions about the disruptive effect of apartheid policies on women's lives by comparing the proportion of all White women married to that of all African women without standardising these by age. Given that population growth among Africans was consistently higher than that among Whites (as well as there being higher mortality among the former), the African population of South Africa was – and is – much younger than the White population. As a consequence, one would expect a smaller proportion of African women to be married, since marriage is strongly correlated with age. While these limitations do not detract from the substance of Bernstein's argument, they indicate the extent to which basic demographic understandings have been absent from the literature on the effects of apartheid[4].

Two other factors contributed to the limited demographic research on South Africa. Apartheid policies and racial capitalism led many researchers (both local and international) to view South Africa as being not fully 'African', with the consequence that the country tended to be ignored in discussions of the demography of the sub-continent. Furthermore, South Africa's frequent omission from international statistical series (such as those published by the United Nations and the World Bank) meant that

[4] A notable exception is the work of Charles Simkins, an economist, who derived population projections and investigated the demographic consequences of migration in the 1970s and 1980s (see, for example, Simkins (1983))

data for South Africa were difficult to come by outside the country, and hence often ignored by non-specialists. These factors, together with the boycott of South Africa by foreign academics that commenced in earnest in the 1980s, have ensured that the demography of South Africa has remained a *terra incognita* on the international map for much longer than that of any other Southern African country.

The most frequently cited estimates of past African and South African fertility (cited by Caldwell and Caldwell (1993) and Chimere-Dan (1993a) among others) are those from Mostert, van Tonder and Hofmeyr (1987). Table 2.1 shows the "official" estimates of South African fertility from HSRC sources for the period 1945-95. The estimates for the period before 1980, however, need to be treated with more circumspection than has been afforded them by some, since they appear to have been determined as much by the original authors' preconceptions as by the data collected[5].

The political transition that commenced in February 1990 allowed – for the first time in decades – non-governmental agencies to collect new demographic data. The 1993 Living Standards and Development Study (SALDRU, 1994), organised with the assistance of the World Bank, is the first large-scale data set not collected by the South African government or its agencies that can be used to investigate demographic trends in South Africa. While the LSDS is primarily an economic and poverty study, it did collect important demographic data relating to fertility and mortality. In doing so, the study provided researchers with independent and alternative data with which to evaluate the level and context of South African fertility. Fuller and Liang (1999) used this study to explore the relationships between education and other socio-economic variables and teenage pregnancy, while Mencarini (1999) applied the same data to estimate the level and correlates of fertility in South Africa. Large-scale demographic surveillance projects have also been established in the last decade, with the most notable being that conducted at the Agincourt field site on the border between the Northern Province and Mpumalanga.

[5] The authors used the 1936 South Africa Census results to project the African South African population on three different bases, with fertility and mortality assumptions as inputs. The first was a projection that led to an age-structure equivalent to that in the 1970 census; the second a similar projection leading to the population age-structure in the 1980 Census; and the third (the one finally used) "a projection that is based on acceptable fertility rates, if none of the aforementioned projections are acceptable in terms of their fertility estimates" (Mostert, van Tonder and Hofmeyr, 1987:31*).

Table 2.1 "Official" estimates of total fertility in South Africa, 1945-1995

Period	*All South African women*	*African women*
1945-50	6.0	6.8
1950-55	6.1	6.8
1955-60	6.0	6.7
1960-65	6.0	6.7
1965-70	5.8	6.5
1970-75	5.5	6.3
1975-80	4.9	5.8
1980-85	4.6	5.4 - 5.6
1985-90	4.0	4.6
1990-95	3.5	4.0

Source: Mostert, Hofmeyr, Oosthuizen *et al.* (1998) for All South Africans and Africans 1985-95; Mostert, van Tonder and Hofmeyr (1987) for Africans 1945-85. The higher value for Africans in 1980-85 comes from Mostert, van Tonder and Hofmeyr (1987), the lower from Mostert, Hofmeyr, Oosthuizen *et al.* (1998).

Note: Oosthuizen (2000), citing the same sources, gives a figure of 3.6 for Africans in 1990-95. This figure is implausible, given that total fertility in the country was still estimated as 3.5 children per woman. Hence, his discussion on the "plummeting" decline in African fertility after 1980 appears to be based on flawed data.

With the political transition in the country, independent demographers were also granted access to previously restricted data sets. Kaufman's doctoral research (Kaufman, 1996; 1998; 2000) is an important milestone in the analysis of South African demography. She was among the first non-South Africans to gain access to the HSRC's data and archives, and used the 1987-9 DHS-type survey to investigate the political context of reproductive control in South Africa. In so doing, she integrated demographic and political theory to give a subtler and more politically informed account of the dynamics and political context of contraceptive usage during the South African fertility transition than previously existed. Like the Caldwells, though, she was restricted by her inability to read Afrikaans, and had to rely on the assistance of the HSRC's demographers to access and translate much of the historical literature. As a result, several important gaps exist in the literature that she was able to access.

The post-apartheid government's statistical agency, Statistics South Africa, has also become more willing to present and share demographic analyses. This has contributed to the debate on the level of fertility in South Africa. Two reports (Udjo, 1997; 1998) presenting analyses of South African fertility using the 1995 October Household Survey (OHS) and the 1996 South Africa Census have been issued and the first independent assessments of the current level of fertility in the country using the 1996 South Africa Census have started to emerge (Dorrington, 1999; Dorrington, Nannan and Bradshaw, 1999). A summary of published estimates of total fertility in South Africa using data collected since 1993 is shown in Table 2.2. It is evident that even with the additional data now available, estimates of the level of South African fertility still vary substantially.

Table 2.2 Estimates of total fertility in South Africa using data collected since 1993

Author and year of publication	*Population*	*Data Source*	*Year(s) to which estimate applies*	*TFR*
Sibanda and Zuberi (1999)	African	1996 census	1985	5.2
Mencarini (1999)	African	1993 LSDS	1984-88	4.8
Sibanda and Zuberi (1999)	African	1996 census	1990	4.7
Mencarini (1999)	African	1993 LSDS	1989-93	3.7
Sibanda and Zuberi (1999)	African	1996 census	1995	3.1
Dorrington, Nannan and Bradshaw (1999)	African	1996 census	1996	3.6
Sibanda and Zuberi (1999)	African	1996 census	1996	3.0
Department of Health (1999)	African	1998 DHS	1996-8	3.1
Udjo (1997)	All	1995 OHS*	1980	4.2
Udjo (1997)	All	1995 OHS	1985	3.5
Sibanda and Zuberi (1999)	All	1996 census	1985	4.5
Udjo (1997)	All	1995 OHS	1990	3.3
Sibanda and Zuberi (1999)	All	1996 census	1990	4.2
Udjo (1997)	All	1995 OHS	1995	3.2
Sibanda and Zuberi (1999)	All	1996 census	1995	2.9
Udjo (1998)	All	1996 census	1996	3.3
Dorrington, Nannan and Bradshaw (1999)	All	1996 census	1996	3.2
Sibanda and Zuberi (1999)	All	1996 census	1996	2.8
Department of Health (1999)	All	1998 DHS	1996-8	2.9

* October Household Survey – a fairly small annual survey conducted by Statistics South Africa to provide basic econometric and demographic data, and used to derive mid-year population estimates.

2.3 Birth spacing and contraceptive use in sub-Saharan Africa

In the absence of easily available modern methods of contraception, birth spacing in sub-Saharan Africa traditionally has been shaped by long durations of breastfeeding and postpartum abstinence (Greene, 1998; Schoenmaeckers, Shah, Lesthaeghe *et al.*, 1981). A common theme running through the literature on fertility in the region, however, is that cultural change and modernisation, in the absence of changes in contraceptive use, shorten the duration of both postpartum abstinence and breastfeeding, "thus increasing the risk of short intervals between births" (Greene, 1998). Many authors suggest that modern contraceptive methods are being used increasingly for birth spacing in their place, rather than for birth limitation (see, for example, Cohen, 1993; Greene, 1998; Kirk and Pillet, 1998).

Data giving the median birth interval for thirteen sub-Saharan countries, presented by Greene (1998) and shown in Table 2.3, indicate that there is some variation in median birth intervals across the sub-continent, ranging from 28 months in Madagascar and Uganda to 39 months in Zimbabwe. Countries in this sample that neighbour South Africa (Zimbabwe and Namibia) have longer intervals and, *a priori*, one might expect birth intervals for African South African women to be of a similar magnitude.

Table 2.3 Median birth intervals (months) for births in the three (or five) years prior to the DHS, to non-sterilised married and cohabiting women, 13 sub-Saharan African countries

Country (Year)	*Median birth interval (months)*
Madagascar (1992)	28
Uganda (1995)	28
Kenya (1993)	31
Malawi (1992)	32
Rwanda (1992)	32
Senegal (1992-3)	32
Tanzania (1991-2)	32
Côte d'Ivoire (1994)	33
Namibia (1992)	33
Zambia (1996)	33
Benin (1996)	36
Ghana (1993)	36
Zimbabwe (1994)	39

Source: Greene (1998:32)

Birth intervals, and their determinants, have received only cursory attention in the literature on South African demography. With the exception of the surveys conducted between 1969 and 1970 by the HSRC in four major metropolitan areas (Mostert, 1972; Mostert and du Plessis, 1972; Mostert and Engelbrecht, 1972; Mostert and van Eeden, 1972) that indicated a mean closed birth interval length of around 30 months, no data relating to birth intervals in South Africa have been published.

However, the literature on birth spacing and birth intervals elsewhere in sub-Saharan Africa is possibly inappropriate to South Africa, and of little help in understanding the changes in South African birth intervals over the last 30 years. This literature refers mostly to West and Central African societies. South Africa is far more urbanised and industrialised and wealthier than any other country in the region, as Table 2.4 shows. Furthermore, the racialised pattern of political, economic and social development in South Africa means that few similarities exist between the South African and other economies in the region.

Table 2.4 Economic and spatial characteristics of Southern African countries

Country	*Population (m)*	*GDP (PPP $ bn)*	*GDP per capita ($)*	*Percent urban*
South Africa	42.9	296.1	6900	50
Namibia	1.7	7.1	4300	36
Swaziland	1.0	4.2	4200	30
Botswana	1.5	5.7	3900	27
Zimbabwe	11.0	26.5	2400	31
Lesotho	2.1	4.7	2240	22
Kenya	28.2	45.1	1600	27
Mozambique	18.7	18.7	1000	33
Zambia	9.7	8.5	880	43
Tanzania	42.4	23.3	550	24

Source: Population and economic data come from the CIA World Factbook (2000), urbanisation data from the United Nations Centre for Human Settlements Report (United Nations, 1996). Population and economic data refer to 1999, data on urbanisation to 1994.

Schoenmaeckers, Shah, Lesthaeghe *et al.* (1981) indicate that, historically, postpartum abstinence of a year or more was common among all the larger ethnic groups in South Africa: the Zulu, Xhosa, Venda, Tsonga and Basotho. However, the comparatively industrialised and urbanised South African economy means that the anthropological inquiries pursued by the contributors to Page and Lesthaeghe (1981), for example, may not add greatly to our understanding of the dynamics of childbearing in South Africa, except for purposes of historical comparison.

Cultural change and modernisation have been important features of South African society for the better part of forty years. As early as the 1950s and 1960s, research into the lives of urban Africans (Pauw, 1963) revealed a syncretism of modern and traditional beliefs and practices, with both subject to continual reinterpretation. This process still continues (van der Vliet, 1991). Even studies conducted in very traditional and rural parts of the country point out the degree to which these communities interact with, and are affected by, broader social influences (see, for example, Kuckertz (1990)). However, beliefs and practices are not the only aspects of culture that have been subject to change. Recent ethnographic research in South Africa (James and Kaufman, 1997) shows that ethnic identity itself is increasingly fluid and constantly shaped and reshaped according to the social situations in which people find themselves. In these circumstances, it is unlikely that cultural determinants of postpartum abstinence and breastfeeding have remained strong among African South Africans. Evidence from the 1998 South Africa Demographic and Health Survey supports this view. The mean length of postpartum abstinence (across all parities and age groups) between births among African women is 8.4 months, which is much shorter than that suggested above as an historical average.

2.4 Institutional analysis

Beyond the determination of levels of, and trends in, fertility and birth intervals in South Africa, the thesis seeks to demonstrate the value of adopting an explicitly institutional framework in order to understand better the dynamics of the South African fertility decline. This section sets out the sociological thinking underpinning the institutional analysis of changes in fertility, defining what is meant by 'institution', and tracing the genesis of the application of institutional analysis to the investigation of fertility decline in developing countries. The advantages of adopting an institutional approach to the analysis of fertility declines are also discussed.

2.4.1 What are institutions?

In his theory of structuration, Anthony Giddens (1984, 1990) argues that the role of individuals and individual action ("agency") has been neglected and marginalised in the analysis of institutions and social change. The economic and development studies literatures, for example, have tended to adopt narrow, structuralist definitions of institutions. In the development studies literature, North (1989:1321) defines institutions as the "rules, enforcement characteristics of rules, and norms of behaviour that structure repeated human interactions". Thus, the definition of institutions in these disciplines places much greater emphasis on the manner in which structure constrains social behaviour than on the potential for individuals to shape and determine that structure.

For Giddens, institutions are not simply "rules", but the "more enduring features of social life" (Giddens, 1984:24). While McNicoll, a demographer, adopts a more rule-based definition of institutions, he also acknowledges that "an essential feature of institutions is that they persist, generating a society's distinctive patterns of social organisation and the texture of social life" (McNicoll, 1994:201).

Giddens identifies three distinct categories of structure, each with their own associated institutional characteristics. The first operates almost entirely at the level of the individual – the "structure of signification", which finds its institutional expression in modes of discourse and communication between individuals. The second is the "structure of domination", made manifest by political and economic institutions that determine the modes of resource authorisation and allocation respectively. The final category, which is that most generally associated with institutions, is the "structure of legitimation"– given content by legal and moral institutions that determine and regulate normative behaviour.

Central to the theory of structuration is what Giddens terms the "reflexivity of social action", the processes whereby individuals actively engage with, and recast, the institutions that surround them. Thus, according to Giddens,

> we should not conceive of the structures of domination built into social institutions as in some way grinding out 'docile bodies' who behave like the automata suggested by objectivist social science. Power within social systems which enjoy some continuity over time and space presumes regularised relations of autonomy and dependence between actors or collectivities in contexts of social interaction. *But all forms of dependence offer some resources whereby those who are subordinate can influence the activities of their superiors.* (Giddens, 1984:16, emphasis added)

Hence, for Giddens, structure (and institutions) are "always both constraining and enabling" (Giddens, 1984:25). In the demographic literature, McNicoll (1994) has adopted what amounts to a Giddensian analysis, arguing that

> in the familiar opposition between structure and agency, institutions by definition have to do with structure. But they are not hard-cast channels that, once set in place, demand compliant behaviour. They are constantly being made and remade by those coming into contact with them, emerging renewed or marginally changed, or falling into disregard and disuse. The role of agency is distinct, although limited. (McNicoll, 1994:201)

Thus, from this sociological standpoint, the constantly shifting balance between structure and agency is of primary importance in understanding the evolution and effect of institutions on social behaviour. Institutional analysis informed by Giddensian social theory, then, seeks to avoid imposing an artificial dichotomy between structure and agency. The structures of domination and legitimation can be used to effect a transformation of social ordering, but simultaneously the structures of signification allow individuals and collectivities to recast and reconstruct their social life and thereby reconstitute patterns of social organisation. Thus, while structure generally determines patterns of social organisation, agency plays an important part in determining changes in those patterns.

Two important insights emerge from this brief discussion of institutions. The first is that the institutions of interest are those that regulate interactions between individuals, and between individuals and the state, but that these institutions are not restricted to those associated with structures of domination and legitimation. Giddens suggests that the structure of signification and its associated institutional order constitute an important institutional domain, lying underneath (but not independent of) dominating and legitimating structures. The relationship between the structures of signification and legitimation, particularly, is analogous to the "informal institutions" of norms and values discussed in the economics and development studies literatures. Since they operate at two different structural levels, these institutions are durable and more difficult for the state to direct or control. As North argues, they possess a "tenacious survival ability because they become an integral part of habitual behaviour" (North, 1989:1324). These institutions are not only more durable, but also they have a tendency (as Putnam (1993:180) argues) to subvert and recast these in their image. The durability and subversive capacity of informal institutions arises in part because the family is one of the key sites for the reproduction of the norms and learned behaviours that constitute them. According to Putzel (1997:946), "one reason why it is so difficult to effect a transformation of informal institutions – of norms and values – is because they are constantly reproduced within the intimacy of the family". Thus, in order for external forces to precipitate a rapid transformation of these institutions, it is necessary that those seeking that change articulate into, and possibly disrupt, family and household dynamics.

Second, institutions are not static, and hence institutional analysis needs to pay more than cursory attention to history and historiography. Socially-sanctioned norms of behaviour, constructs of fairness, the dominant ideology, the economic system, and even the very structure of the state, can and will change over time, either in response to pressures arising from the structures of signification, or from broader secular changes in the external environment. Since institutions are context- and temporally-specific, they, and their social consequences, need to be located within their particular history. Furthermore, historiographical analysis suggests that institutions tend to be path-dependent. By this it is meant that, given an initial starting point, what McNicoll (1994) terms an "institutional endowment", societies will tend to follow particular paths of development and social organisation. Or, as Putnam argues, "path-dependence can produce durable differences in performance between two societies, even when the formal institutions, resources, relative prices, and individual preferences in the two are similar" (Putnam, 1993:179). Path-dependence arises from the fact that the forces of history exert long-term consequences:

> institutions evolve through history, but they do not reliably reach unique and efficient equilibria. History is not always efficient, in the sense of weeding out social practices that impede progress and encourage collective irrationality. On the contrary, individuals responding rationally to the social context bequeathed to them by history reinforce social pathologies. (Putnam, 1993:179)

Institutional analysis, therefore, requires an historical dimension. If institutions are not static, the processes whereby they form and the paths along which they evolve become important. Furthermore, it follows from the above that theories and analyses of social processes (including demographic outcomes such as fertility) that fail to engage with the context in which those institutions emerge and develop, are fundamentally ahistorical. Moreover, the adoption of an historical approach leads to Lonsdale's observation that "for any reasonably significant historical development, monocausal explanation is *ipso facto* wrong" (Lonsdale, 1981:140). Thus, from an historian's perspective, emphasis is placed on detailing the emergence of institutional forms in the fullest way possible in order to understand both the present and the past.

Hence, in the analysis and explanation of fertility decline in a given society from an institutional perspective, there can be no attempt at deriving a monocausal explanation for that decline. Rather, the analysis should focus, as it will here, on the analysis of the development and change in social institutions that shape human reproductive decisions. This too, then, ties in with Giddens' concept of the reflexivity of social action, where social practices, and the institutions that define them, are constantly challenged and changed.

Therefore, there are both historiographical and sociological reasons for adopting an institutional approach to understanding demographic outcomes. These carry implications for demographic theories of the fertility transition. Lonsdale's argument in favour of rich and complex historical explanations (and against those that are simplistic and decontextualised) can be applied to all demographic theories of the fertility decline that seek to predict fertility decline based on just one or two causes. This desire for mono- or bicausal explanations is one of the reasons given by Mason (1997) for the current impasse in the derivation of theories of fertility decline, and accounts for the inadequacies of all major theories of the fertility transition that have emerged from within the demographic discipline. However, as Szreter (1993) has argued, demographic research and theorisation has tended to be driven by policy considerations. In this "real world" approach to the social sciences, the adoption of simpler theories has aided policy formulation by identifying broad similarities in demographic outcomes across both time and space. Hence these more parsimonious demographic theories have the advantage of indicating – in very broad terms – the correlates and possible causes of the fertility transition in a wide variety of settings.

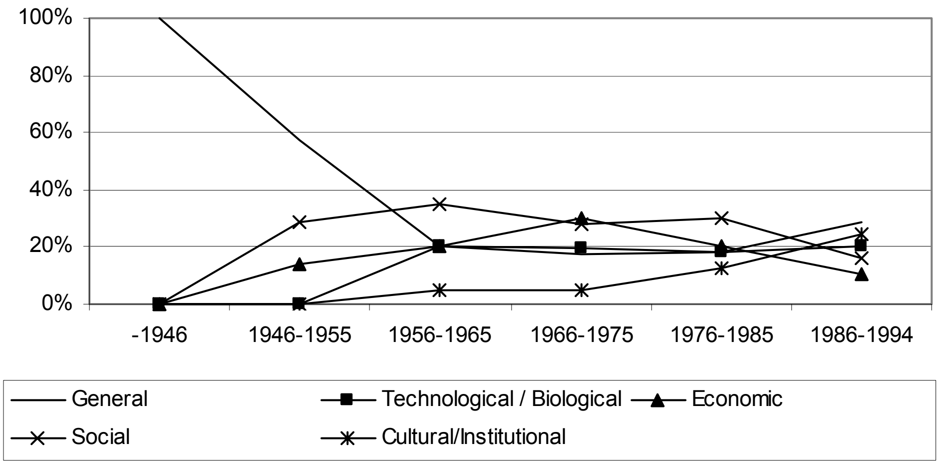
Nevertheless, the theories of fertility decline that have been developed – Mason identifies six – have been subjected to strong and vigorous critiques from social scientists in other disciplines for their failure to accommodate local specificities (Greenhalgh (1990, 1995a, 1995b) and Carter (1995) being the most outspoken). Potter, writing in 1983, has argued much the same point: "in studies of the determinants of fertility, much more attention has traditionally been given to the characteristics of individuals, households and families than to the characteristics of the environments in which they are found" (Potter, 1983:627). This weakness has led Geoffrey McNicoll, probably the foremost demographic theorist on the role of institutions in the fertility decline, to observe that in the fields of demography and population studies, "the institutional structure that underpins – indeed, that virtually constitutes – human society is simply neglected …[a large] part of standard demography [has] no interest in institutions" (McNicoll, 1994:200).

2.4.2 The institutional analysis of fertility decline

The roots of an institutional approach to the understanding of demographic outcomes, and fertility in particular, can be found in the earliest versions of demographic transition theory that appeared in the 1940s. In its original incarnation, in the formulations of Notestein (1945) and Davis (1945), demographic transition theory saw fertility decline as the long-term consequence of modernisation and social and economic development. Thus, in that initial formulation, fertility behaviour was seen as culturally and socially embedded. Fertility change was seen as a long-term process, requiring change – brought on by development – of those institutions that affect fertility.

In his critical history of demographic transition theory, Szreter (1993) has shown how demographic transition theory evolved from this initial statement (which saw the direction of causality running from modernisation to fertility change) into a theory which was, to all intents and purposes, the exact opposite. This inversion (which Szreter dates back to 1952) was not simply a response to a growing demand for programmatic intervention, but also was strongly influenced by the prevailing international political climate, where poverty and underdevelopment were seen as being breeding grounds for communist or socialist insurrection. Thus, according to Szreter, the growing desire in the West, and in the United States especially, for lower fertility in the developing world was a reflection of that fear. Failure to appreciate that intellectual currents in the social sciences and within the development orthodoxy strongly and profoundly affected demographic theorisation limits our understanding of the evolution of a similar orthodoxy within demography and population studies. Demographic theories since the 1950s, therefore, need to be understood within the contexts of a broader political agenda and prevailing debates that were occurring in other disciplines. As Szreter shows, the dominant theories adopted within the demographic literature reflect those agendas and debates. However, while Szreter's history traces the evolution of an intellectual orthodoxy within demography, this orthodoxy was never hegemonic, as van de Kaa (1996) has shown.

Figure 2.2 Distribution of articles on fertility change by theoretical position, 1946-1994



Source: Based on data presented in van de Kaa (1996)

Through an investigation of 450 papers published on the process and pattern of fertility change in more than one country between 1944 and 1994, van de Kaa (1996) shows how different theories of fertility decline have dominated at different points in time (Figure 2.2). Initially, the classic demographic transition narrative dominated entirely, before falling into disfavour. The rise in general descriptions of fertility decline since the 1970s reflects the growing debate on, and empirical testing and historical analyses of, demographic transition theory. Social narratives of fertility decline based on family function and family structure (for example, the work of Bulatao (1982) and Caldwell (1982)) dominated in the years around 1960 and 1980. Economic explanations of fertility decline (epitomised by Becker (1960, 1981), Schultz (1976) and Easterlin (1975, 1978, 1980)) were especially common until the mid-1970s but have been less so since. Articles on fertility decline using the proximate determinants framework, or positing that a decline in mortality is a prerequisite for fertility decline have been common since the 1960s. Explanations of fertility decline based on innovation, diffusion, cultural and institutional factors have come increasingly to the fore in the last two decades, to the point where such articles and explanations now constitute the second biggest class of explanations proffered in the demographic literature.

Institutional approaches to the analysis of fertility decline do not constitute a theory on their own, since their focus on local institutional dynamics (and their path-dependence) precludes prediction of particular patterns in settings outside that under observation. Rather, institutional approaches are a syncretism of three different intellectual strands. They adopt both the sociological concepts of structure and agency and the historiographical imperative to trace the evolution of particular institutions, while not rejecting entirely past intellectual traditions within demographic research. Such approaches suggest that, within the broader narratives and theorisations of the causes and correlates of the fertility transition, understanding the specific institutional conditions under which fertility decline occurs in a specific setting provides a better account of that fertility decline. Thus, according to Greenhalgh, institutional approaches to demography offer

> comprehensive explanations that embrace not only the social and economic, but also the political and cultural aspects of demographic change. They read the history of demographic theorising as saying that there is no single demographic transition, caused by forces common to all places and all times. Rather, there are many demographic transitions, each driven by a combination of forces that are, to some unknown extent, each institutionally, culturally, and temporally specific. (Greenhalgh, 1990:88)

The great advantage of institutional approaches to the analysis of fertility decline is that they allow (and indeed encourage) the integration of macro and micro levels of analysis by acknowledging the fact that individual behaviour is iteratively reconstituted and challenged by institutions (and conversely). In short, our understanding of the dynamics of the fertility transition is enhanced with the use of an institutional framework, or as McNicoll argues,

> rounded explanation, cross-disciplinary range, awareness of theoretical frontiers and historical contingency, and the critical stance that an outsider can bring to self-regarding disciplinary cultures all can work in favour of demography as serious social science as well as (not to be scorned) a neat ordering of events on the Lexis plane. (McNicoll, 1992:414)

Thus, demographers and other social scientists who have adopted an institutional framework argue that demographic processes cannot be divorced or understood in isolation from broader social, economic and political forces, and have sought to reintegrate social theory with demographic research on the fertility decline (see, for example, Greenhalgh, 1990; Greenhalgh, 1995b; McNicoll, 1992 and McNicoll, 1980).

Much demographic analysis seeks to explain fertility change in terms of contraceptive use-effectiveness, or changes in the other proximate determinants or birth parities. At a micro level, however, these explanations are, *in ultimo*, descriptive. They do not explain why the change in fertility has come about at a societal level, or the mechanisms whereby the particular vector has come to be of significance. The implicit assumption frequently made in much of that demographic research is that fertility decisions are made at an individual or household level, and that the household is a discrete, altruistic and utility-maximising entity. Institutional demography, on the other hand, while not negating the precepts of maximisation, draws a close parallel between the processes of production (in an economic sense) and reproduction (in a demographic sense), thereby emphasising the point that utility-maximisation cannot be separated from a broader institutional setting. Thus, for example, Lesthaeghe asserts that the arrangements in society for the regulation of reproductive processes reflect the "basic setup that governs the functioning of the social system as a whole" (Lesthaeghe, 1989:13).

2.4.2.1 Variants of institutional analysis

As the discussion above indicates, institutional approaches to demography believe that demographic processes are not only explained by agency, but that structure is also of importance. Different approaches emphasise the balance between structure and agency to differing degrees. Three slightly different approaches to institutional analysis have been identified in the literature, all of which view fertility, to a greater or lesser extent, as the "social construction of a demographic reality" (Greenhalgh, 1995a).

The first has an explicitly economic foundation, based on transaction theory as originally formulated by Coase (1937) and Ben-Porath (1980). Under this approach, decisions at the household level (including childbearing) are assumed to be the outcome of repeated negotiations or transactions within the household. Thus, according to Fapohunda and Todaro, "family structure affects the locus of reproductive decision making, the formation of reproductive goals, and actual fertility behaviour" (Fapohunda and Todaro, 1988:590). While this approach moves the locus of analysis away from the individual and takes some cognisance of institutions affecting fertility, it does not seek to interrogate the effect of the state and local communities, and the pressure and influence that these exert on the negotiations that occur within the household, or indeed on the composition of households. Because this approach does not accommodate investigation of institutions beyond the household, it is not used or discussed further here.

The second and third approaches share many similarities but differ, according to Greenhalgh (1990), primarily in their starting points. The second is that advocated by Greenhalgh herself, an explicitly political-economic framework that directs attention to "the embeddedness of community institutions in structures and processes, especially political and economic ones, operating at regional, national, and global levels, and to the historical roots of those macro-micro linkages" (Greenhalgh, 1990:87). It adopts a top-down strategy, commencing with an analysis of the global structures of power and domination, and how these in turn affect nations, local communities and – finally – impinge on individual reproductive behaviour. The third approach, which is adopted here, is that developed and applied to demographic analysis by Geoffrey McNicoll. It also integrates macro- and micro levels of analysis and is thus essentially similar to the second outlined above, except that the route of analysis operates in the opposite direction. The method also results in a political-economic analysis of fertility. As a consequence, the accounts of fertility decline that result from the adoption of either the second or the third approaches are fundamentally similar. The thesis adopts the latter because it has been employed successfully in the demographic literature (most notably by McNicoll himself) and even if it is not entirely accepted, it is at least familiar to demographers.

The starting premise for this last approach is that fertility is not simply a biological process, determined solely by the rational economic choices of individuals. Instead, fertility is viewed as a social phenomenon in which the reproductive choices made by individuals are constrained and affected by the political, economic and social institutions that exist in a given society at a given time. According to this perspective, human reproduction like other forms of social behaviour, is not hermetically sealed against broader social trends and forces, but is directly and powerfully affected by them. Individuals and couples can (and do) make decisions about their childbearing. However, these choices cannot be understood outside the context in which those decisions are made[6] or, as McNicoll puts it, "fertility transition, whatever else it may be, is an institutional phenomenon" (McNicoll, 1994:206).

This theorisation is not entirely abstruse to understanding the institutional determinants of the fertility transition. An early work on the institutional determinants of the fertility decline (Potter, 1983) suggested that institutions affected fertility precisely through changing the perceived costs and benefits of childbearing; changing internalised values relating to marriage, the family and fertility; and through the social and administrative pressures that can be brought to bear on reproductive behaviour.

In other words, institutions mediate individual decisions on childbearing in an important and fundamental way. A simple example of this is that of China under the "one-child policy": even if women (or couples) desire more than a single child, political, economic and social sanctions are placed on further childbearing. In this example, it is easy to see how institutions (and the state, in particular) regulate individual behaviour.

The subsections that follow investigate the role played by institutions and the state in shaping the dynamics of fertility decline in a particular setting.

2.4.2.2 Institutions and the role of the state in the fertility transition

The discussion in Section 2.4.1 indicates that institutions are both dynamic and context-specific. Hence, the set of institutions assumed to impact on fertility outcomes must be determined by reference to both the temporal period of investigation and local particularities. This necessity notwithstanding, McNicoll suggests a list of institutions that, in most situations, have a bearing on fertility by virtue of the fact that they give "rise to local patterns of social organisation – particularly the family and local

[6] The economic analogy to this is Herbert Simon's theory of the "bounded rationality" of economic choices (Simon, 1955), of which McNicoll's approach represents a demographic application.

community; family and property law and the local dimension of public administration; the stratification system and mobility paths it accommodates; and the labour market" (McNicoll, 1994:206). By this definition, state ideology, the economic structure of society, and the relative weight and interpretation lent by society to concepts of social and administrative justice, fairness and equality (amongst others) are also important insofar as they affect those "local patterns of social organisation". Other institutions that fit this description include the social construction of gender relations, the legal system itself and the fiscal stance of the state.

The role of the state in the course of the fertility decline is of particular importance in the analysis of fertility change from an institutional perspective. Whether or not the state can direct a process of fertility change, one thing is certain: the state, by the mere fact of its very existence, cannot *not* influence fertility (McNicoll, 1998). The acknowledgement that the nature of state-individual relations may bear strongly on individuals' reproductive intentions (and hence on the efficacy of population programmes) brings the role of the state into sharper focus.

Furthermore, the state's virtual monopoly on the means of violence implies that it should not be viewed as a disinterested party in the development and evolution of institutions. It, too, is contested, and has a strong incentive to afford the highest priority to its own survival. Thus, the state is not hegemonic and is subject to contestation not only from individuals, but from groupings in society that try to capture the state to force it to do their bidding, or to act specifically in their interests. Accordingly, the state can, and frequently does, establish, protect and maintain those institutions that serve its own needs through military, coercive or administrative measures, while simultaneously attempting to gain greater purchase over informal institutions through its attempts to dictate those patterns of behaviour that are deemed to be socially optimal or desirable. Thus, even if the state cannot direct informal institutions, it can still exercise a substantial indirect influence on them. The extent to which informal institutions are durable, and their ability to affect formal institutions, is therefore closely linked to the state's ability and desire to use its power to assert control over them.

The extent to which the state, and the population programmes that are implemented by it, can affect fertility has been the subject of extended research and debate. Debates about the effects of family planning programmes on the level of wanted and unwanted fertility have gone back and forth (see, for example that sparked off by Pritchett (1994a), and the comments on and replies to the article, Bongaarts (1994); Knowles, Akin and Guilkey (1994); Pritchett, (1994b)). Bongaarts (1997) concludes that strong family planning programmes – measured by the somewhat elusive concept of 'programme effort' – have led and will continue to lead to substantial declines in fertility. In a particularly South African context, Oosthuizen (2000:85) argues that "the impact of the South African family planning programme on the demographic transition in this country can hardly be underestimated". As the evidence presented in this thesis will argue, there are few – if any – grounds for this assertion.

The bulk of the literature on the effect of population programmes, unfortunately, remains fundamentally atheoretical (and untestable) insofar as they ignore, as McNicoll (1998) argues, the impossibility of "addressing the counterfactual of what would have happened in the programmes' absence". From an institutional perspective, the capability of the state to directly influence reproductive behaviour is probably limited. In the first instance, as Potter observes, "national policies are confined to programmatic attempts to increase the availability of contraceptive services, and to convince people that low fertility is in their own, as well as the nation's, best interest" (Potter, 1983:654). Furthermore, mere assessment of "programme effort" also does not take into account that these policies may come up against unresponsive (or even hostile) interest groups, particularly if the state can not articulate into local communities. Success is likely to be greater where the reach of the state is greater.

McNicoll (1996) elaborates further on the role played by the state in governing the process of fertility decline and identifies two routes whereby the state, irrespective of its initial institutional endowment, can attempt to gain purchase on the pace of fertility transition, although its success in the pursuit of either or both of these is still contingent on the initial institutional endowments and characteristics. The first route McNicoll terms *regularity*: the state's ability to create and maintain order and, in particular, orderliness (predictability, or non-arbitrariness) of state-individual and individual-individual relations. The second is *duress*, "the use of political or administrative pressure or, at the extreme, physical force to attain fertility objectives" (McNicoll, 1996:17).

In a more recent paper, McNicoll (1998) further develops his analysis of the role played by the state in directing fertility in both transitional and post-transitional societies. Irrespective of official programmes or desired demographic outcomes, he argues, the state exerts an influence on fertility by virtue of the fact that any polity "sustains a demographic regime: the set of routine behaviours surrounding cohabitation, marriage, childbearing and "health-seeking," and their antecedents or supports in patterns of socialisation, organisation, and economic activity" (McNicoll, 1998:12).

Five ways in which the state can affect fertility are proposed:

1. through the development, funding and management of population programmes
2. through the socio-legal and administrative regime maintained by the state
3. through the state's determination of equity and equality in society
4. through micro-effects on household economies via public expenditure and transfer payments
5. through its ability to appeal to "symbols of national identity and cultural continuity" (McNicoll, 1998:13)

Chapter 6 argues that all five of these mechanisms can be identified in the actions of the apartheid state, even if most of them arose as unintended consequences of other government policies.

Further developing and applying the concept of path-dependency outlined in Section 2.4.1, McNicoll (1994) suggests that the combination of institutional endowments found in a particular setting determines the pattern of fertility decline observed. Some combinations permit rapid fertility decline while others retard the process. Five archetypes of institutional endowment are identified, broadly associated with different geographic regions, ranging from "traditional capitalist" through to the "soft state", "radical devolution", "growth with equity" and "lineage dominance". In this typology, he argues, the "radical devolution" (e.g. China) and "growth with equity" (East Asia) archetypes have been associated with the most rapid fertility transitions, while societies with institutional arrangements characterised by "lineage dominance" (e.g. sub-Saharan Africa) have shown the slowest pace of fertility decline.

Casterline makes a similar point about the effect of path-dependency on the pace of the fertility decline: "path-dependency can result in changes that proceed either more quickly or more slowly than would be expected" (Casterline, 1999:36). This thesis argues that the related concepts of historicity and path-dependence play a central part in institutional analyses of the process of fertility change in South Africa.

2.4.3 Conclusion: Institutional analysis

This section has set out the underlying principles and motivations for adopting an institutional approach to the analysis of the fertility decline. It has argued that there is an important place for sociological and historiographical techniques and theories in the narrative of the process of fertility decline in a single setting, something that has been absent from much of the demographic literature. Social and political theory has set out mechanisms whereby individual behaviour is mediated by other social forces, while historiography emphasises the necessity of charting the evolution of institutions in their social context, and the role played by path-dependent outcomes, in helping us understand the patterns of fertility decline seen in a given setting.

The approach adopted is thus not in conflict with classical demographic theory. Rather, it builds on those theories, and seeks to explain better the pattern of fertility decline. In a review of theories and narratives of the fertility decline over the last fifty years, van de Kaa (1996) concluded that

> Overall sufficient material has been accumulated to conclude that path-dependency and institutional aspects are mainly responsible for the regional flavour which can be detected in the demographic transition process. And further, the initial transition narrative is too deterministic in nature, too general, and so far removed from concrete societal settings that it leaves insufficient room to account for differences in institutional endowments and the fortuitous elements present even in path-dependent processes. (van de Kaa, 1996:428)

Furthermore, the approach outlined above, which takes history and institutions into account, suggests that greater attention should be paid to the historical and socio-political analysis of national fertility declines, and that commensurately less weight should be afforded to the standard methods of technical demography in such analyses. This is not to argue that there is not a role for these techniques. They have a valuable part to play in the determination of demographic trends. Rather, in attempting to understand why a particular fertility transition has taken the form it has, institutional analysis can offer insights that cannot be gained from those standard demographic techniques. Hence, the statistical determination of correlation, association and causality in the analysis of demographic outcomes from an institutional perspective is regarded as more peripheral, and not as an end in itself. Thus, McNicoll (1992) suggests that

> the methodological ingredients are here for rich explanatory accounts of changing demographic regimes, interweaving historical contingency, social dynamics, and cultural

> idiosyncrasy. In constructing such accounts, formal multivariate analysis would have a properly subordinated part. Public policy roles would find their natural level in explanation: very likely, population-specific polices would appear far less important than claimed in the heat of the debate, other domains of public policy (and sheer fortuity) much more important. (McNicoll, 1992:411)

2.5 Conclusion

This literature review has established the fundamental precepts underlying the thesis. First, earlier research shows that the fertility decline in South Africa differs from that in other countries in sub-Saharan Africa. The question has been raised as to whether the South African fertility decline is indeed comparable to that in other African countries.

Second, reasons why the level of and trend in South African fertility is less well-known than that in most other developing countries have been discussed. A combination of international isolation, state suspicion and hostility, and a paucity of demographic skills inside the country has hampered demographic research in South Africa. The increased availability of both current and historical data sources, as well as archival material means that a new opportunity has been created to reassess the dynamics of the South African fertility transition without undue reliance on government and other official statistics. This reassessment is attempted in Chapter 3, using census and survey data to establish both the current level of, and past trends in, fertility in South Africa.

Third, almost no literature exists – and certainly nothing recent – on patterns of birth spacing in South Africa. Evidence from elsewhere in sub-Saharan Africa is also sketchy, but is unlikely to be of assistance in understanding the changes in birth intervals that have occurred in South Africa. The 1998 South Africa Demographic and Health Survey, together with earlier demographic survey data, however, makes such investigations possible. Thus, Chapter 4 investigates the changing patterns of childbearing and birth intervals among African South African women since 1970, as well as seeking to identify similarities and differences between the patterns of childbearing in South Africa and in other sub-Saharan African countries.

The conceptualisation of institutions as set out by both Giddens and McNicoll Giddens is essential to this thesis. The nature of official population polices, the manner in which they were implemented by successive apartheid governments, and the responses of the populace to them, forms a central plank in the analysis and explanation of the specificities of the South African fertility transition. Chapters 5 and 6 adopt the theoretical approach to the institutional analysis of fertility set out above, and apply it to the case of the South African fertility transition. In doing so, an account of the evolution of official rhetoric and policy on population matters in South Africa is developed, which is then used to inform an analysis of the effect of apartheid social institutions on fertility change in South Africa.

3 THE SOUTH AFRICAN FERTILITY DECLINE: ESTIMATES OF CURRENT AND PAST FERTILITY

This chapter presents estimates of the current and past trend in South African fertility derived from recent and historical data. Section 3.1 describes the data sources used and the methodologies employed to collect the data. Section 3.2 compares and contrasts the data from the two most recent sources, the 1996 South Africa Census and the 1998 South Africa Demographic and Health Survey (DHS), and identifies differences and possible sources of error in the populations described by each data set. Section 3.3 presents a detailed discussion of the fertility data (and their limitations) contained in the 1996 census. The corrections and adjustments made to improve the quality of these data are set out and discussed before presenting estimates of fertility in South Africa in the late 1990s in Section 3.4. Using data from the 1970 and 1996 censuses, retrospective estimates of fertility in South Africa, for all South Africans and for African South Africans separately, are derived using reverse-survival techniques in Section 3.5. The penultimate section examines the cohort-period fertility rates derived from the 1998 South Africa DHS. Section 3.7 discusses the results from the preceding sections, draws some conclusions about the nature of the South African fertility decline since 1960, and compares the age pattern of fertility in South Africa with that observed in other sub-Saharan African countries.

3.1 Data sources

The two sources of data used to determine the current level of fertility in South Africa are the 10 percent public-use sample from the 1996 South Africa Census, and the 1998 South Africa Demographic and Health Survey (DHS). In addition, data from the 1970 South Africa Census are used to determine historical trends in fertility in the country.

3.1.1 1996 South Africa Census

The 1996 South Africa Census was the first conducted in South Africa after the demise of apartheid, and was carried out on behalf of the South African government by the Central Statistical Service (now Statistics South Africa). The official census date was the night of 9-10 October 1996, but fieldwork was conducted over a three-week period from 10-31 October. A post-enumeration survey (PES) in November 1996, together with detailed matching of records between the census and the PES, indicated that the undercount in the census was 10.7 percent (Statistics South Africa, 1998a), and varied by province (from 8.7 percent in the Western Cape to 15.6 percent in the Northern Cape). According to Statistics South Africa, infants and young adult men were particularly prone to under-enumeration, while Africans and Coloureds were less likely than Whites and Indians/Asians to have been enumerated. Statistics South Africa suggests that this pattern of underenumeration reflects different levels of urbanisation, and difficulties in achieving comprehensive coverage in rural areas (Statistics South Africa, 1998a: 20-21).

Statistics South Africa has made a 10 percent sample of the data available to researchers and included a weighting variable, designed to correct for the undercount as well as for the fact that the sample provided comprises one tenth of those enumerated. The data provided are drawn from a systematic sample of households, stratified by Enumeration Areas based on province and District Council. The individual-level data file includes all members of selected households, as well as a 10 percent systematic sample of people in "special institutions" (old-age homes, prisons, schools etc.) and workers' hostels. Full details of the methods employed to derive the household sample are given in the documentation provided with the data (Statistics South Africa, 1998b).

The raw data were checked and adjusted for double counting, as well as other errors, and cleaned and validated before they were released. However, the algorithms employed have not been published, making it impossible to assess the extent of imputation or modification of the data between the raw and final forms or to arrive at an independent judgement of whether any bias could have been introduced by this cleaning.

3.1.2 1998 South Africa DHS

The 1998 South Africa Demographic and Health Survey (DHS) was co-ordinated by the Medical Research Council of South Africa (MRC) on behalf of the South African Department of Health. Technical assistance was provided by Macro International Inc.

The South Africa DHS employed a two-stage sample selected from the 1996 census demarcations. The census' Enumeration Areas were used, and sample numbers of households were derived in proportion to those in the census. For reasons explained in the Preliminary DHS report (Department of Health, 1999), the sample was not designed to be self-weighting at a national level. Sample weights are provided with the DHS data, and are used to adjust the responses collected to be representative of the underlying population.

3.1.3 1970 South Africa Census

The results from the 1970 South Africa Census are used to derive estimates of South African fertility for the period 1955 to 1970. The data were provided on CD-Rom by Statistics South Africa, and contain a 100 percent sample of Whites, Coloureds and Asians/Indians, and a 5 percent sample of Africans. No sample weights for Africans were provided, so data for Africans have been multiplied by 20 where necessary.

The quality of the 1970 census data for Africans is not nearly as good as the 1996 census. Strong digit-preference exists in the reporting of ages. Whipple's Index of digit preference for ages ending 0 or 5 is 140 for men aged 18 to 52, and 153 for women of the same ages. According to a United Nations scale, these values classify the reliability of the age data as "rough" (Newell, 1988). In addition, noticeable troughs exist in the reported population at age 1 for both sexes, and an even greater undercount of male infants in this census is apparent.

Unfortunately, too, the information asked of African women in the 1970 census about their childbearing and recent fertility no longer exist, thereby preventing the estimation of African women's fertility in 1970 and the late 1960s directly from the data. Despite these deficiencies, the 1970 census provides the best demographic data for the South African population prior to the 1987-9 South Africa "DHS" (described in Chapter 4, and used in the analysis of birth intervals in South Africa), and allows the derivation of estimates of South African fertility for earlier periods than is possible using only the 1996 census and 1998 DHS data.

3.2 Comparison between the 1998 DHS and 1996 census data

This section provides an overview of the attributes of the female population of South Africa aged 15-49 as documented by the 1996 census and the 1998 DHS. In the first instance, the distribution of these women by age, province of residence (*de facto* and *de jure*[1]), and attained level of education are compared. Where discrepancies clearly originate in one of the data sets, this is pointed out. In general, however, it is hard to ascribe differences in the reported distributions to problems with one or the other inquiry.

The distribution of South African women of reproductive age by their background characteristics is shown in Table 3.1. Table 3.2 shows the same distributions for African women.

[1] *De facto* residence refers to the province in which women were enumerated or surveyed; *de jure* refers to women's "usual" province of residence.

Table 3.1 Background characteristics of South African women aged 15-49

	1998 DHS All South African women 15-49			*1996 census All South African women 15-49*		
Background Characteristic	*Weighted %*	*Weighted N*	*Unweighted N*	*Weighted %*	*Weighted N*	*Unweighted N*
Age						
15-19	19.2	2249	2373	19.5	2135672	190557
20-24	17.7	2075	2086	18.9	2067653	182607
25-29	15.8	1857	1811	16.3	1790412	158317
30-34	14.1	1654	1616	14.8	1617576	144323
35-39	13.9	1636	1628	12.6	1375399	123101
40-44	11.0	1294	1255	10.1	1105325	99650
45-49	8.3	970	966	7.9	863268	78684
Residence						
Urban	60.5	7095	6518	57.7	6321903	565041
Non-urban	39.5	4640	5217	42.3	4633401	412198
Province (de facto)						
Western Cape	10.2	1193	919	10.2	1120698	102114
Eastern Cape	13.3	1566	2756	14.6	1600910	142883
Northern Cape	2.2	253	1041	2.0	221107	18758
Free State	6.5	763	936	6.6	721896	65760
KwaZulu-Natal	20.1	2364	1826	21.0	2296584	200083
North West	7.7	909	931	8.1	891976	80913
Gauteng	21.7	2552	1057	19.4	2120387	190981
Mpumalanga	7.0	819	1131	6.8	749418	65977
Northern Province	11.2	1316	1138	11.2	1232330	109770
Province (de jure)						
Western Cape	10.3	1210	953	10.0	1093522	99748
Eastern Cape	13.2	1553	2728	14.3	1561831	139716
Northern Cape	2.4	279	1038	2.0	214823	18269
Free State	6.7	787	951	6.5	707481	64506
KwaZulu-Natal	20.0	2345	1813	20.4	2230458	194533
North West	7.6	894	927	8.0	875358	79401
Gauteng	21.6	2534	1063	19.0	2084731	187788
Mpumalanga	7.0	822	1134	6.8	742996	65411
Northern Province	11.0	1294	1119	11.0	1202493	107278
Other country	0.0	4	2	2.2	241613	20589
Missing	0.1	12	7	0.0	0	0
Education						
No education	6.8	804	810	11.5	1259929	111956
Primary	24.8	2916	3134	23.6	2587923	230455
Secondary	60.5	7103	6929	55.3	6062741	541518
Higher	7.8	912	862	5.9	649052	58166
Other / Missing	0.0	0	0	3.6	395660	35144
Population group						
African	77.9	9147	8993	76.4	8369644	744577
Coloured	10.2	1201	1533	9.2	1011770	90343
White	7.8	916	755	10.8	1179002	105736
Asian	3.5	406	393	2.8	305130	28533
Missing	0.6	66	61	0.8	89759	8050
Total	**100**	**11735**	**11735**	**100**	**10955305**	**977239**

Source: 1998 DHS and 1996 census

Table 3.2 Background characteristics of African South African women aged 15-49

	1998 DHS African women 15-49			*1996 census African women 15-49*		
Background Characteristic	*Weighted %*	*Weighted N*	*Unweighted N*	*Weighted %*	*Weighted N*	*Unweighted N*
Age						
15-19	19.7	1802	1910	20.6	1725039	153891
20-24	19.1	1746	1704	19.7	1646314	145236
25-29	16.0	1460	1380	16.5	1379924	121598
30-34	13.7	1257	1211	14.7	1226909	109089
35-39	13.5	1236	1209	12.1	1011310	90070
40-44	10.5	958	911	9.4	789731	70963
45-49	7.5	688	668	7.1	590416	53730
Residence						
Urban	53.3	4873	4274	48.1	4022753	357513
Non-urban	46.7	4274	4719	51.9	4346891	387064
Province (de facto)						
Western Cape	3.2	294	223	3.0	253916	22982
Eastern Cape	14.6	1338	2410	16.4	1374009	122578
Northern Cape	0.8	73	305	0.9	74946	6427
Free State	7.2	659	808	7.3	613515	56152
KwaZulu-Natal	21.0	1922	1370	22.4	1872755	161876
North West	9.1	828	851	9.7	813826	73770
Gauteng	21.4	1957	819	18.0	1506955	134695
Mpumalanga	8.6	788	1094	8.0	667507	59536
Northern Province	14.1	1288	1113	14.2	1192215	106561
Province (de jure)						
Western Cape	3.5	316	261	3.0	247831	22440
Eastern Cape	14.5	1324	2380	16.0	1342567	119953
Northern Cape	1.1	97	312	0.9	72608	6263
Free State	7.4	677	818	7.2	602868	55247
KwaZulu-Natal	20.8	1907	1360	21.7	1815066	157046
North West	8.9	812	841	9.6	799870	72501
Gauteng	21.3	1949	829	17.7	1484229	132676
Mpumalanga	8.6	790	1094	7.9	661431	58995
Northern Province	13.8	1262	1091	13.9	1164313	104209
Other country	0.0	2	1	2.1	178861	15247
Missing	0.1	10	6	0.0	0	0
Education						
No education	8.2	747	710	14.1	1177405	104605
Primary	27.7	2537	2606	27.0	2258219	200816
Secondary	58.5	5353	5168	52.6	4402487	392001
Higher	5.6	511	509	3.5	297012	26475
Other / Missing	0.0	0	0	2.8	234521	20680
Total	**100**	**9147**	**8993**	**100**	**8369644**	**744577**

Source: 1998 DHS and 1996 census

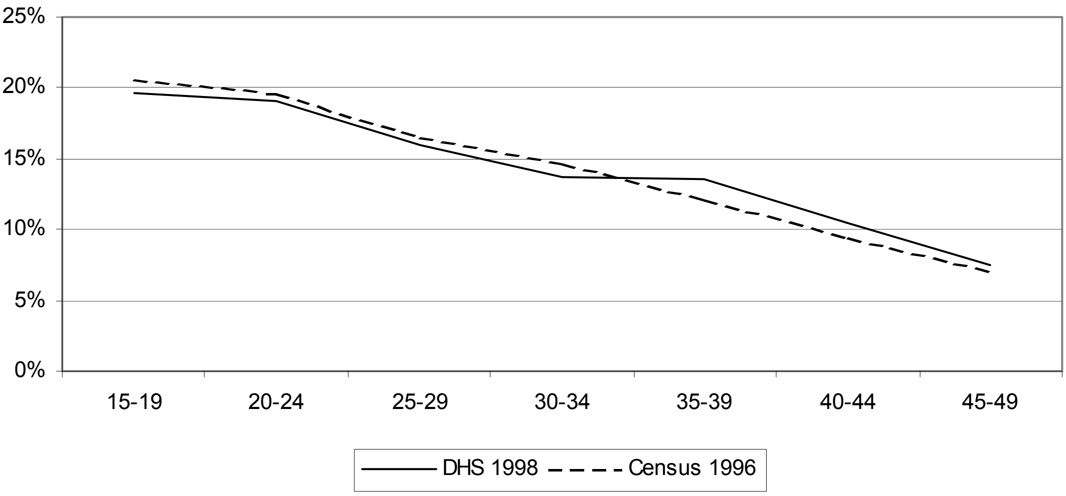
In aggregate, the DHS describes a population that is more urbanised, marginally older, and better educated than the census results suggest. Additionally, the DHS finds more women of reproductive age living in Gauteng (and fewer in the Eastern Cape and KwaZulu-Natal), and reports a higher proportion of African, Coloured and Asian women (and fewer White women) than the census. The differences in reported levels of education between the DHS and the census may not be "real," but rather a reflection of enumerator error or misstatement by respondents in the census.

The following sections investigate these background characteristics for African women in greater detail.

3.2.1 Age

The DHS data describe a population that is, on average, 0.4 of a year older than the population enumerated in the census, with the distribution of women by age in the DHS finding smaller proportions at younger ages, and higher proportions at older ages, as shown in Figure 3.1. The distribution of the African population by age also suggests that the DHS interviewed too many women aged 35-39 relative to women aged 30-34.

Figure 3.1 Percent distribution of African women aged 15-49, by age group



3.2.2 Urban residence

The DHS describes a more urbanised population than the census. Table 3.3 shows the proportion of African women living in urban areas by age group in the DHS and census.

Given that fertility is generally lower in urban areas than rural areas, the national estimates of fertility from the DHS will, *ceteris paribus*, be lower than those derived from the census. The age pattern of urban residence in the DHS also reveals a particular error in those data. The proportion of women living in urban areas is highest in the 40-44 age group, while the proportion of women living in urban areas in the 35-39 age group is lower than that reported in either of the adjacent age groups. It is likely that rural women aged 40-44 had a tendency to report that they were aged less than 40, thereby artificially inflating the rural population in the 35-39 age group, and deflating the rural population among women aged 40-44. This error would also explain the relatively large proportion of the population in the DHS survey reported as being aged 35-39, relative to the size of the population in the adjacent age groups[2].

Table 3.3 Proportions and numbers of African women aged 15-49 living in urban areas by age group

	1998 DHS			1996 census		
Age group	*Weighted %*	*Weighted N*	*Unweighted N*	*Weighted %*	*Weighted N*	*Unweighted N*
15-19	45.0	812	767	38.0	654870	58330
20-24	52.6	917	794	47.1	775140	68222
25-29	56.1	819	691	53.2	652504	58056
30-34	57.7	725	633	53.0	731915	64494
35-39	54.9	679	606	52.3	528889	47115
40-44	58.0	556	461	50.5	399092	35817
45-49	53.2	366	322	47.5	280343	25479
Total	**53.3**	**4873**	**4274**	**48.1**	**4022753**	**357513**

Source: 1998 DHS and 1996 census

A further implication of this error is that the fertility estimates from the DHS for women aged 40-44 are likely to be biased downwards, while those for women aged 35-39 are likely to be biased upwards.

3.2.3 Province of residence

Differences also exist between the DHS and census in the provincial distribution of African women of reproductive age. Two measures of residence were captured by each inquiry, *de jure* (i.e. usual place of residence), and *de facto* (i.e. residence at the time of data collection, either on the census night itself, or on the day the household was interviewed). There are no substantial differences between the *de facto* and *de jure* measures of residence in the two data sets, although the DHS found smaller discrepancies between the two measures than the census. In part, this can be attributed to differential coverage of women whose *de jure* residence was a country other than South Africa. Such individuals accounted for approximately 2.1 percent of African women of childbearing age in the census, while the DHS recorded only two women as being usually resident in a foreign country.

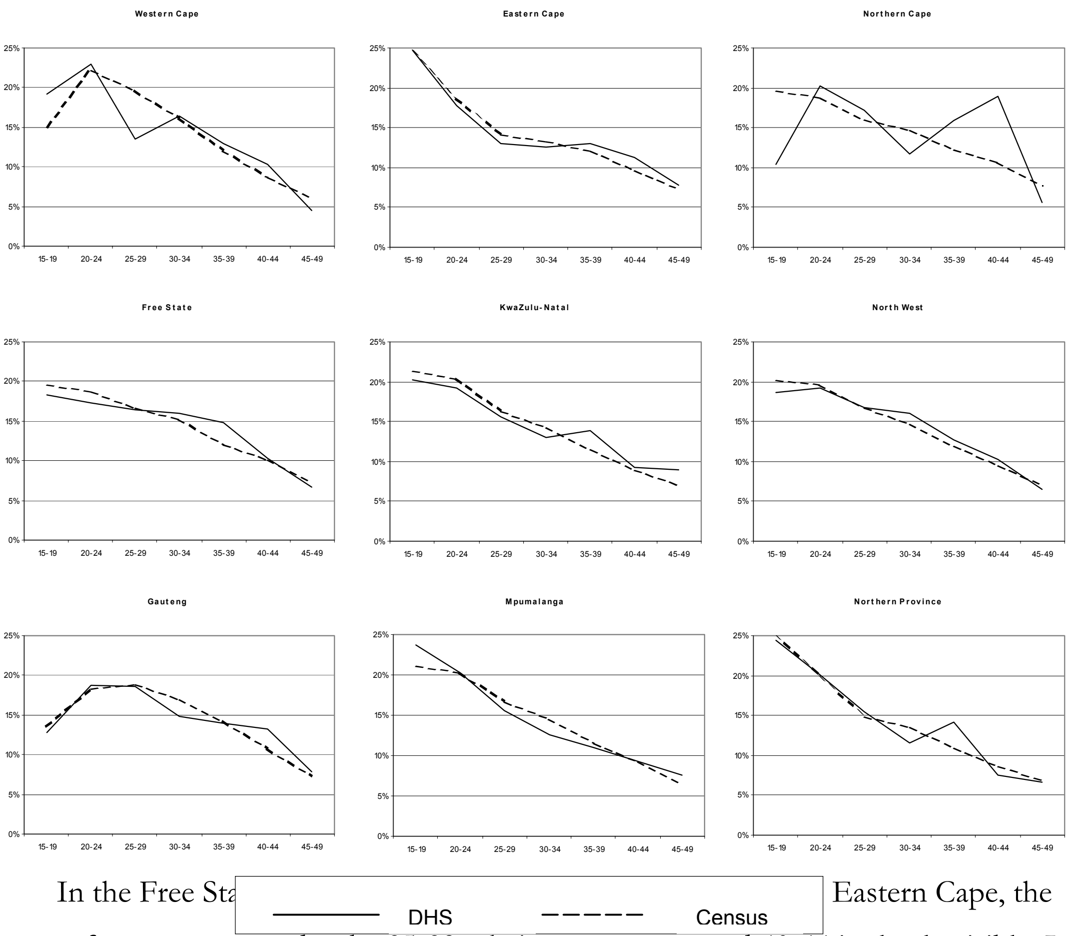
The DHS and census data are reasonably similar in the Northern Cape, Free State, Northern Province and Northern Cape. However, a fairly big difference exists between the samples for Gauteng (the proportion of the population in Gauteng is 3.5 percent greater in absolute terms in the DHS than the census) and the Eastern Cape (the DHS

[2] One might speculate that this reluctance to admit to being 40 is less of a problem in the census because many women's ages were reported by proxy respondents.

found a smaller proportion of the population in this province than the census). Noticeable, but smaller, differences in the samples can be discerned in KwaZulu-Natal and the North-West (DHS under-represented) and Mpumalanga (DHS over-represented).

This pattern, together with the data presented in Table 3.3, suggests that either the DHS failed to accurately cover the more rural Eastern Cape and North-West provinces, or that census enumerators experienced difficulties in enumerating in Gauteng and the census PES failed to correct fully for this. Such differences have implications for the analysis of fertility in South Africa, since it is well-established that sizeable differentials in fertility by province exist (Dorrington, Nannan and Bradshaw, 1999), partly arising from differences in the residential composition of the provincial populations. Figure 3.2 presents the age distributions of African women in each of the nine provinces.

Figure 3.2 Percent distribution of African women aged 15-49, according to age group and province of usual residence, 1998 DHS and 1996 census



In the Free St[...] Eastern Cape, the excess of women reported to be 35-39 relative to women aged 40-44 is clearly visible. In these more rural provinces, age misstatement was a significant problem among older women. The highly irregular age distribution of African women in the Northern Cape is a function of the small population (less than 1 percent of all African South Africans) in that province.

The age distribution of African women in Gauteng is very different from that in other provinces. This could be indicative of consistently falling fertility in the region over the last 25 years, but is more likely to be due to the high rates of labour migration into the province once women have completed their education. Furthermore, while there was age understatement in the more rural provinces, there seems to have been age exaggeration in Gauteng, with women in the DHS aged 30-34 reporting their ages as 35-39, and those aged 35-39 reporting their ages as being 40-44.

Even allowing for the relatively small numbers of Africans in the Western Cape surveyed for the DHS, the age distribution of Africans in that province, especially at ages 25-29, is problematic.

3.2.4 Education

Just as notable differences by age and regional composition are found between the DHS and the census, so differences exist in the reported levels of education of African women of childbearing age. The DHS describes a much better educated population than does the census, with fewer women being reported as having no or only primary education, and more with secondary or higher education. Except in the youngest age groups (where women may have yet to complete their education), these differences cannot be ascribed to the 18-month interval between the two surveys. Likewise, differences between the two sets of data cannot be ascribed to differences in the form of the questions on education: both surveys asked respondents to state the highest level of education actually completed.

These differences persist after allowing for the fact that the age distributions of the populations in each data set differ, as shown in Table 3.4. The DHS reports much fewer women with no education, and more women with post-secondary education, than the census does after stratifying by age.

Table 3.4 Percent distribution of African women aged 15-49 by age group and completed level of education

		Completed level of education			
Age group		*None*	*Primary*	*Secondary*	*Tertiary*
15-19	1998 DHS	0.9	23.0	74.6	1.4
	1996 census	4.8	29.7	64.7	0.8
20-24	1998 DHS	1.7	15.3	75.2	7.8
	1996 census	7.4	18.1	72.0	2.5
25-29	1998 DHS	4.8	22.9	63.3	9.0
	1996 census	11.0	23.2	60.7	5.1
30-34	1998 DHS	9.8	30.9	52.2	7.2
	1996 census	16.2	30.2	48.0	5.7
35-39	1998 DHS	14.9	33.7	45.8	5.6
	1996 census	22.2	33.5	38.7	5.5
40-44	1998 DHS	16.6	42.7	37.0	3.7
	1996 census	29.0	35.2	31.3	4.5
45-49	1998 DHS	23.7	44.5	28.6	3.2
	1996 census	34.9	35.0	26.7	3.4

Source: 1998 DHS and 1996 census

3.2.5 Comparability of the 1998 DHS and 1996 census data

The 1996 census and 1998 DHS data are not directly comparable. First, the aims of the 1998 South Africa DHS were very different from those of the census. While the census aimed to provide a complete enumeration of the South African population (and its main demographic characteristics) in October 1996, the purpose of the DHS was to collect detailed data on demographic and health variables within the country to assist policy making in the health sector (Department of Health, 1999). Second, the DHS was conducted approximately 18 months after the census. With declining fertility (and rising mortality due to the HIV/AIDS epidemic), this difference may matter. Fertility measures from the DHS based on reported fertility in the three years before the interview, classified by age of mother at birth, however, refer to the census date.

Third, the census and the DHS differed markedly in their questionnaires and in their data collection procedures. Fieldworkers administering the DHS were better trained than the census enumerators. No proxy respondents were used in the DHS, whereas in the census, enumerators asked questions of one person about all of the household's members. In addition, DHS fieldstaff were women, which should have minimised any reticence on the part of respondents to discuss matters relating to sexual behaviour and childbearing. Further, the census asked only summary questions about the fertility of women aged 12-49 in the household, while the DHS collected detailed birth histories and data on child health and welfare from female respondents aged between 15 and 49.

Proxy responses in the census may have exacerbated the observed differences between the DHS and the census in the socio-economic and other characteristics of South African women of childbearing age, for the reason that if the respondent was not the woman in question, he/she may not have had full knowledge of the information required. Thus, the marital status, educational and fertility variables relating to women of childbearing age (as well as their reported ages) in the census may suffer somewhat from a certain amount of imputation (or guessing).

One advantage of the census data, however, is that the large size of the 10 percent sample produces reasonable distributions of the South African population, even when the data are subjected to a high degree of disaggregation. The much smaller DHS sample generally does not permit analysis of fertility (or, indeed, any other demographic outcome) by more than a few characteristics at a time.

3.3 Fertility data in the 1996 census

The census asked two questions from which South African fertility can be assessed. The first question was "How many children, if any, has the woman ever given birth to?" The second was "How many children (live births), if any, has she given birth to in the last twelve months?" Responses to the first question were not collected for a significant proportion of women of childbearing age. Moreover, it appears that many respondents did not fully understand the second question, or that their responses were recorded inaccurately. Unadjusted, the census data cannot provide robust estimates of fertility and a series of corrections are necessary to obtain better estimates from these data. The corrections made are presented in the following sections.

3.3.1 The El-Badry Correction

The first adjustment made to the census data uses the El-Badry correction to adjust for the fact that many of the women of childbearing age who did not respond to the first of the two fertility questions are evidently childless. El-Badry (1961) observed that – in the majority of cases, and especially at younger ages – women who are enumerated as "parity not stated" are, in fact, childless, and that the enumerator has omitted to write zero on the form. He proposed a method of adjusting the recorded non-response to allow for this by apportioning the reported not stated cases between true not stated cases and women of zero parity, using the strongly linear correlation that exists between the proportion of childless women, and the proportion of women for whom parity was not recorded.

If $Z^*(i)$ is the true proportion of women in age group *i* who are childless, and $NS(i)$ is the reported proportion of women in age group *i* whose parity is not stated, then the correlation above can be described mathematically as

$$NS(i) = \alpha Z^*(i) + \beta, \quad (1)$$

where α is the "true" proportion of childless women in age group *i* who were incorrectly recorded as parity not stated, and β is the true, constant across all age groups, proportion of women whose parity is not stated. Further, since $\alpha Z^*(i)$ represents the proportion of childless women whose parity was misclassified, the reported proportion of childless women, $Z(i)$, can be found from

$$Z(i) = (1- \alpha)Z^*(i). \quad (2)$$

Rearranging (2) to make $Z^*(i)$ the subject of the formula, and substituting in (1) gives

$$NS(i) = \gamma Z(i) + \beta, \text{ where } \gamma = (\alpha/1-\alpha), \quad (3)$$

from which an estimate of the true value of $Z^*(i)$ can be found by fitting a line to the reported points $\{Z(i), NS(i)\}$ for age groups 15-49, and estimating the parameters γ and β to give

$$Z^*(i) = Z(i)+(NS(i)-\beta). \quad (4)$$

Table 3.5 shows the proportion of women 15-49 whose parity was not stated, and the values of α and β, by population group, in the 1996 census.

Table 3.5 Summary statistics arising from the El-Badry correction, by population group

Population group	*% of women with parity not stated*	*% of childless women reported as parity not stated (α)*	*True % of women of not stated parity (β)*
Africans	15.3	33.9	3.3
Coloureds	9.7	25.8	1.1
Asians/Indians	17.1	37.9	0.7
Whites	10.7	25.8	0.3

The numbers of childless women in the census can then be estimated by summing the reported numbers of childless women and the estimated numbers of childless women who were erroneously recorded as being of unstated parity. The consequence of this adjustment is that estimated lifetime fertility, mean children ever borne, is also adjusted downwards (Table 3.6).

Table 3.6 Effect of the El-Badry adjustment on mean children ever borne, by age and population group

	Africans		*Coloureds*		*Asians/Indians*		*Whites*	
Age group	*Before*	*After*	*Before*	*After*	*Before*	*After*	*Before*	*After*
15-19	0.23	0.16	0.18	0.14	0.07	0.05	0.06	0.04
20-24	0.91	0.75	0.79	0.68	0.53	0.33	0.35	0.29
25-29	1.74	1.58	1.52	1.42	1.34	1.20	1.02	0.92
30-34	2.69	2.55	2.24	2.16	2.06	1.94	1.67	1.58
35-39	3.48	3.35	2.82	2.75	2.43	2.32	2.05	1.96
40-44	4.16	4.05	3.27	3.19	2.71	2.61	2.24	2.15
45-49	4.61	4.50	3.74	3.66	2.92	2.78	2.40	2.31

A further adjustment was made to the current fertility data in the census arising from the El-Badry adjustment. Clearly, if a woman has never had children, she will not have borne a child in the twelve months before the census. Hence, the reported numbers of childless women reporting no births in the twelve months before the census were set to be equal to the adjusted numbers of childless women arising from the application of the El-Badry correction. The resultant adjusted age-specific fertility rates by age and population group are shown in Table 3.7.

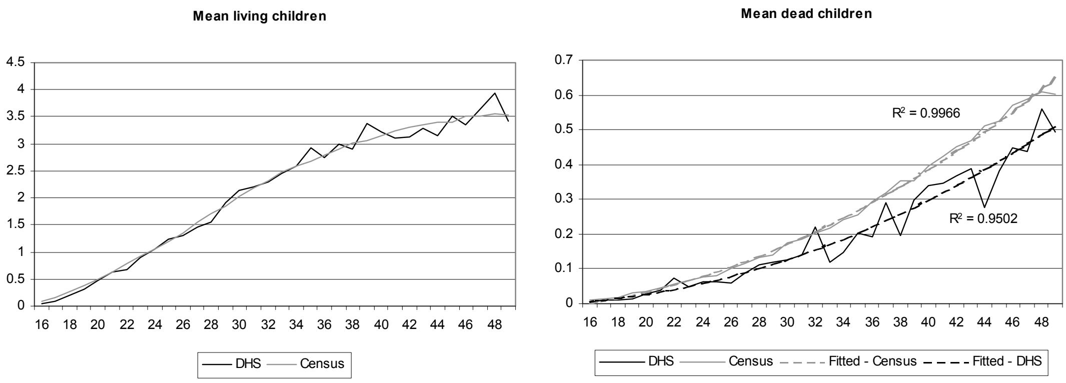
Table 3.7 Effect of the El-Badry adjustment on age-specific fertility rates, by age and population group

	Africans		*Coloureds*		*Asians/Indians*		*Whites*	
Age group	*Before*	*After*	*Before*	*After*	*Before*	*After*	*Before*	*After*
15-19	0.050	0.036	0.048	0.037	0.013	0.009	0.013	0.009
20-24	0.104	0.086	0.105	0.092	0.087	0.055	0.063	0.052
25-29	0.117	0.107	0.121	0.113	0.112	0.101	0.110	0.099
30-34	0.127	0.120	0.095	0.091	0.086	0.081	0.082	0.078
35-39	0.113	0.108	0.066	0.064	0.048	0.046	0.046	0.044
40-44	0.096	0.094	0.050	0.049	0.035	0.034	0.035	0.033
45-49	0.080	0.078	0.035	0.035	0.035	0.033	0.033	0.031
TFR	**3.44**	**3.14**	**2.60**	**2.40**	**2.09**	**1.80**	**1.91**	**1.73**

3.3.2 Correction in respect of stillbirths

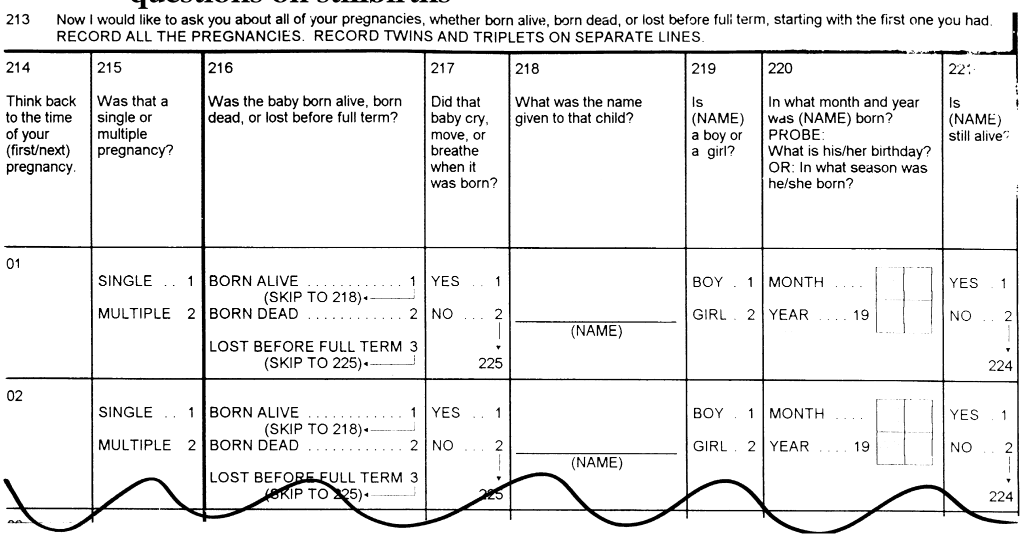
The second correction makes allowance for the inclusion of stillbirths in the reported number of children ever borne. Comparison of the DHS and census data showing the numbers of children ever borne that have died, and children reported as still living (by age of mother) reveals higher numbers of dead children at all ages in the census, while the reported numbers of children still living are very similar (Figure 3.3). For reasons set out below, there are strong grounds for believing that this reflects the erroneous inclusion of stillbirths among women's enumerated children ever borne in the census.

Figure 3.3 Mean living and mean dead children for all South African women, by age



Although the census question on lifetime fertility[3] specifically instructed enumerators and respondents to exclude stillbirths, the wording of the question was ambiguous, in that the final words in parentheses may have led enumerators to include stillbirths among the children that have died. The questionnaire used for the DHS, on the other hand, included a specific question on stillbirths, as shown in Figure 3.4.

Figure 3.4 Extract from the 1998 South Africa DHS questionnaire, showing questions on stillbirths



213 Now I would like to ask you about all of your pregnancies, whether born alive, born dead, or lost before full term, starting with the first one you had. RECORD ALL THE PREGNANCIES. RECORD TWINS AND TRIPLETS ON SEPARATE LINES.

214 Think back to the time of your (first/next) pregnancy.	215 Was that a single or multiple pregnancy?	216 Was the baby born alive, born dead, or lost before full term?	217 Did that baby cry, move, or breathe when it was born?	218 What was the name given to that child?	219 Is (NAME) a boy or a girl?	220 In what month and year was (NAME) born? PROBE: What is his/her birthday? OR: In what season was he/she born?	221 Is (NAME) still alive?
01	SINGLE .. 1 MULTIPLE 2	BORN ALIVE .... 1 (SKIP TO 218) BORN DEAD .... 2 LOST BEFORE FULL TERM 3 (SKIP TO 225)	YES .. 1 NO ... 2 225	(NAME)	BOY . 1 GIRL . 2	MONTH .... YEAR 19	YES . 1 NO .. 2 224
02	SINGLE .. 1 MULTIPLE 2	BORN ALIVE .... 1 (SKIP TO 218) BORN DEAD .... 2 LOST BEFORE FULL TERM 3 (SKIP TO 225)	YES .. 1 NO ... 2 225	(NAME)	BOY . 1 GIRL . 2	MONTH .... YEAR 19	YES . 1 NO .. 2 224

In addition to Question 216, which enquired about the outcome of each pregnancy, Question 217 probed more deeply if the woman responded that her child had been born dead. Women surveyed in the DHS reported a total of 24 464 pregnancies and that the foetus was lost before full-term in 1 198 of these, and "born dead" in another 407. Question 217 revealed that only 75 of these children showed any sign of life. The other 332 were stillbirths. However, as the mothers reported that these 332 pregnancies ended in a birth, it seems likely that in the census such stillbirths would have been reported as (dead) live births, inflating the actual number of children dying before age 5 by about 22 percent.

An adjustment was made to correct the data for this error. Based on the additional questions in the DHS, and the answers to them, it seems likely that the reported numbers of children ever borne to women interviewed in the DHS successfully exclude stillbirths. Assuming this to be the case, an estimate of the number of stillbirths returned as live births in the census can be derived by fitting polynomial curves to the proportion of dead children in each set of data. Subtracting the curve fitted to the DHS data from that fitted to the census data gives a smoothed estimate of the inclusion of stillbirths by mother's age in the census. Figure 3.3 shows the curves fitted to the national population (i.e. all races). The difference between the two curves suggests that, on average, about 0.1 stillbirths per woman were reported as live births at older ages in the census.

The scale of this error varies markedly by population group. While clear evidence exists of the inclusion of stillbirths among Coloured and African women, the data for Whites and Asians/Indians (although the sample sizes of these two groups in the DHS were small) reveal no discernible evidence of inclusion of stillbirths in the census vis-à-vis the DHS. Thus, the adjustment for stillbirths was not applied to these groups.

After generating the smoothed estimates of the inclusion of stillbirths by individual year of age, a correction was made to the reported mean children ever borne (CEB) by individual age, by subtracting the smoothed estimate from the reported CEB, and aggregating (using the weights in the census) into quinquennial groups. Estimated numbers of stillbirths included in the census for Africans and Coloureds (by age of mother) are shown in Table 3.8.

The El-Badry-corrected estimates of children ever borne to African and Coloured women were then further corrected for African and Coloured women to compensate for the inclusion of these stillbirths. A (lower) revised estimate of the number of women at each parity in each age group was derived by subtracting the estimated stillbirths from

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[3] The exact wording of the question (Question 15.1) was "How many children, if any, has the woman ever given birth to? (live births). (Please include her children, who are not living with her and those who have died)."

each parity and interpolating, assuming a constant inclusion of stillbirths across all parities. This adjustment has the effect of further reducing the estimated mean children ever borne.

Table 3.8 Estimated number of stillbirths reported as live births in the 1996 census, and corrected estimates of mean children ever borne (CEB), African and Coloured women

	Africans			Coloureds		
Age group	*Number of still births*	*CEB: El-Badry*	*CEB: El-Badry - stillbirth*	*Number of still births*	*CEB: El-Badry*	*CEB: El-Badry - stillbirth*
15-19	0.003	0.16	0.16	0	0.14	0.14
20-24	0.017	0.75	0.74	0.010	0.68	0.68
25-29	0.038	1.58	1.55	0.038	1.42	1.39
30-34	0.065	2.55	2.50	0.059	2.16	2.11
35-39	0.098	3.35	3.27	0.071	2.75	2.68
40-44	0.137	4.05	3.92	0.075	3.19	3.12
45-49	0.183	4.50	4.33	0.071	3.66	3.60

Note: The revised CEB are not exactly equal to the El-Badry CEB less the estimated number of stillbirths due to the interpolation procedure used (see text).

3.3.3 Age-specific fertility rates after application of the El-Badry and stillbirth adjustments

The first correction made to the current fertility data arises from the application of the El-Badry correction to the numbers of women of zero parity (and hence zero births in the last year), and was described earlier. Then, working only with the data where there was a numeric response to both fertility questions in the census, the reported numbers of women at each parity after application of the El-Badry correction (and correcting for the inclusion of stillbirths in the case of African and Coloured women) were distributed across reported births in the last year in the same proportions as in the unadjusted data. From these, tabulations of births in the last year and children ever borne, by population and age group, were derived.

Table 3.9 Age-specific fertility rates after correction for reporting stillbirths as live births, by age and population group

Age group	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.036	0.037	0.009	0.009
20-24	0.085	0.091	0.055	0.052
25-29	0.105	0.111	0.101	0.099
30-34	0.118	0.090	0.081	0.078
35-39	0.106	0.063	0.046	0.044
40-44	0.091	0.048	0.034	0.033
45-49	0.076	0.034	0.033	0.031
TFR	**3.08**	**2.37**	**1.80**	**1.73**

The adjustment in respect of stillbirths has a small effect on the estimated age-specific fertility rates for African and Coloured women. The estimated age-specific fertility rates for Asians and Whites remain unchanged, since the adjustment in respect of stillbirths was not applied, but are shown in Table 3.9 for the sake of completeness.

3.3.4 Correction for errors resulting from births in the last year being recorded as children ever borne

Further problems exist with the data on current fertility in the census. A significant proportion of enumerators or respondents seems not to have appreciated the distinction between the two questions, and recorded the same answer (i.e. children ever borne) to both. Consequently, large numbers of women report upward of three children born in the 12 months preceding the census. These responses are likely to have arisen either from misinterpretations of the two fertility questions or through errors in the cleaning of the data by Statistics South Africa. This error has severe implications for the calculation of age-specific fertility rates and total fertility from the census data unless it is compensated for. Older women tend to have had more children, and hence age-specific fertility rates calculated without adjusting for this error are particularly exaggerated at the older age groups.

To correct for this, all women of parity two or greater who reported the same number of births in the last year as in their lifetime were treated as "not stated" births in the last year.

Table 3.10 Percent reduction in estimated age-specific fertility rates after correcting for reporting of children ever borne as births in the last year, by age and population group

Age group	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	2.3	2.5	0.0	3.1
20-24	8.8	4.1	3.0	6.6
25-29	19.7	9.3	6.4	6.6
30-34	29.9	17.2	23.9	15.9
35-39	35.2	27.8	35.4	36.1
40-44	43.9	45.4	47.4	57.1
45-49	51.1	61.2	61.6	66.5

The effect of this adjustment is significant for all population groups, and especially at older ages, as can be seen from Table 3.10. The estimated age-specific fertility rates after this adjustment are shown in Table 3.11.

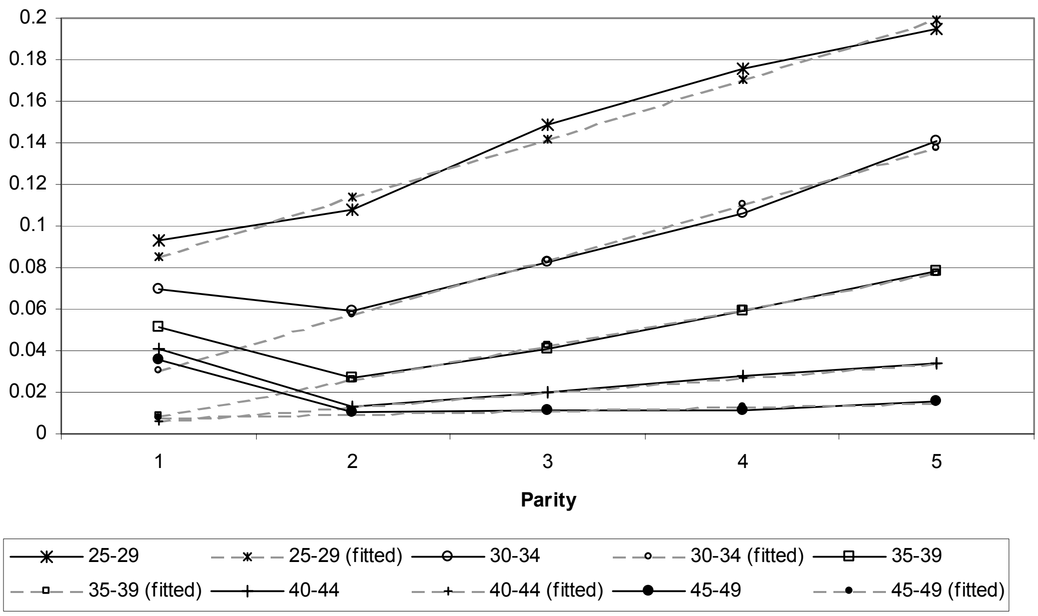
Table 3.11 Age-specific fertility rates after correcting for reporting of births in the last year as children ever borne, by age and population group

Age group	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.035	0.036	0.009	0.009
20-24	0.078	0.087	0.053	0.048
25-29	0.084	0.100	0.094	0.092
30-34	0.083	0.074	0.062	0.065
35-39	0.069	0.045	0.030	0.028
40-44	0.051	0.026	0.018	0.014
45-49	0.037	0.013	0.013	0.011
TFR	**2.18**	**1.91**	**1.39**	**1.34**

3.3.5 Correction for women of parity one reporting one birth in the last year

Further examination of the data showed that the proportion of women of parity one who reported a single birth in the 12 months prior to the census was also implausibly high relative to women of other parities who reported a single birth in the same year. For women aged 25 and older, a clear linear trend by parity exists in the proportion of women having a birth in the 12 months prior to the census (Figure 3.5). This effect is most pronounced in the older age groups.

Figure 3.5 Actual, and estimated, proportions of South African women reporting a single birth in the 12 months prior to the census, by parity and age group



By extrapolating these trends in the age-group specific data, revised estimates of the numbers of women of parity one in each of these age groups who had a birth in the 12 months before the census were derived. The excess number of births in the last year was assumed to represent women of parity one who had not given birth in the 12 months before the census.

3.3.6 Women reporting more than one birth in the year before the census

It is impossible for women to have more than two maternities in any given 12-month period, and the DHS showed very low levels (around 1 percent) of multiple births in the 12 months before the survey. Accordingly, the census data were adjusted further by prorating all births in excess of one reported in the 12 months before the census to 0 and 1 births in the period. This further reduces the estimated level of total fertility slightly.

The estimated age-specific fertility rates resulting from the last two adjustments are shown in Table 3.12.

Table 3.12 Age-specific fertility rates after correcting for misreporting of recent births by older women of parity one, and after prorating births in the last year of more than one, by age and population group

Age group	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.035	0.036	0.009	0.009
20-24	0.077	0.087	0.053	0.048
25-29	0.077	0.098	0.094	0.091
30-34	0.067	0.067	0.046	0.059
35-39	0.052	0.041	0.023	0.020
40-44	0.031	0.018	0.012	0.010
45-49	0.016	0.009	0.005	0.007
TFR	**1.77**	**1.78**	**1.21**	**1.23**

For all population groups, once the data are adjusted to allow for women who report impossibly large numbers of births in the last year and childless women who are coded as parity not stated, the estimated levels of total fertility are implausibly low, as the adjustments made have the effect of eliminating about half the births that were reported as having occurred in the 12 months before the census. It is therefore clear that once one adjusts for problems with the coding and misinterpretation of the question, not all births that actually occurred in the 12 months before the census were reported.

Thus, other reporting errors affect these data. Accordingly, two further adjustments were made to the data to produce reasonable estimates of South African fertility. First, a Relational Gompertz model was used to correct the shape of the fertility distribution for African and Coloured women (Section 3.3.7). Reasonable estimates of recent fertility in South Africa were then derived using a variant of Brass' P/F method, which estimates the current level of fertility from the lifetime fertility of women at the average age of childbearing (Feeney, 1998; United Nations, 1993).

3.3.7 Fitting of Relational Gompertz models to the 1996 census data

Relational Gompertz models provide a useful way of evaluating the extent of age reporting errors and underreporting of births in census and survey data, and for correcting distortions in the shape of the fertility distribution arising from these errors. The technique, developed by Zaba (1981), is a variant of the P/F method insofar as it uses reported lifetime fertility (i.e. parities) to adjust for biases in the reported current level of fertility (the age-specific fertility rates). However, the model relies on the applicability of a standard fertility distribution, which is inappropriate for use with the White and Indian/Asian populations. Hence the technique was not applied to these sub-populations. Additionally, while the technique can correct for distortions in both the level and the shape of the fertility distribution, the correction of the fertility level requires the assumption that there has been no time trend in fertility. As this assumption is unreasonable in the context of the South African fertility decline, the model was used simply to correct the shape of the fertility distribution for African and Coloured women.

Age-specific fertility rates based on the adjusted census data (Table 3.12), and the estimated mean children ever borne by age group (adjusted using the El-Badry technique, and corrected for the inclusion of stillbirths, shown in Table 3.8) were used as inputs into the model. It was fitted using the F-points only (since the intention was only to correct the shape of the fertility distribution) using data on the 15-19 through 35-39 age groups, as comparison of the data with the standard distribution revealed significant age reporting errors for women in their forties. The estimated age-specific fertility rates are shown in Table 3.13, for all population groups, although those for Whites and Indians/Asians remain unchanged from Table 3.12, and are shown again only for completeness' sake.

Table 3.13 Age-specific fertility rates after application of the Relational Gompertz model, by age and population group

Age group	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.036	0.037	0.009	0.009
20-24	0.076	0.093	0.053	0.048
25-29	0.078	0.089	0.094	0.091
30-34	0.067	0.066	0.046	0.059
35-39	0.051	0.042	0.023	0.020
40-44	0.027	0.017	0.012	0.010
45-49	0.005	0.002	0.005	0.007
TFR	**1.70**	**1.73**	**1.21**	**1.23**

3.3.8 Analysis of the effects of the adjustments applied to the census data

Table 3.14 shows the percent contribution that each adjustment discussed so far makes to the reduction in estimated fertility by population group. It is immediately apparent that, for all population groups, the two single biggest contributors to the reduction in the estimated total fertility are the adjustments arising in respect of women's lifetime fertility being enumerated as current fertility, and the El-Badry correction. For all groups, these two effects account for between 68 and 83 percent of the reduction in the level of total fertility from the unadjusted census data to the estimates presented in Table 3.13. The restriction of the analysis to only one birth in the 12 months preceding the census is particularly important for Africans.

Table 3.14 Percent contribution to the reduction in estimated fertility of each of the adjustments to the census fertility data, by population group

Correction	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
Unadjusted total fertility	**3.44**	**2.60**	**2.09**	**1.91**
El-Badry correction	16.8	22.9	33.5	26.0
Stillbirths correction	3.6	4.0	N/A	N/A
Correction for births in the last year equal to children ever borne	51.8	51.9	45.7	57.2
Correction in respect of parity 1 women	5.3	6.8	12.2	12.5
Restriction to 1 birth in the last year	18.2	8.8	8.5	4.2
Gompertz model	4.2	5.7	N/A	N/A
Adjusted total fertility	**1.70**	**1.73**	**1.21**	**1.23**

Note: N/A: Correction not applied

3.3.9 Adjustment of the level of fertility using Feeney's approach

While the shape of the adjusted fertility distributions for each population group is reasonable, the level of fertility implicit in the fertility rates presented in Table 3.13 is clearly not. One final adjustment was made to the data to correct the level of fertility using a variant of the Brass P/F ratio method suggested by Feeney (1998).

The Brass P/F ratio method uses reported average parities, $P(i)$ – derived from Table 3.8 – and the period fertility rate (Table 3.13) to calculate the P/F ratio, where F is the estimated parity equivalent (i.e. the parity that, according to a model schedule, is associated with the reported period fertility rate, after adjustment for the six month difference between age of mother at survey and age of mother at birth). Values of the P/F ratio by population and age group are shown in Table 3.15.

Table 3.15 P/F ratios, by age and population group

Age group	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	2.06	1.71	2.99	2.65
20-24	1.87	1.50	1.94	1.83
25-29	1.96	1.51	1.97	1.62
30-34	2.17	1.62	2.09	1.68
35-39	2.27	1.72	2.15	1.78
40-44	2.40	1.85	2.25	1.86
45-49	2.56	2.09	2.31	1.90

The P/F ratios measure the difference between the reported parities, and the estimated parity equivalents based on reported current fertility, and it is not readily clear how to apply them when fertility is declining. However, Feeney (1998) has argued that under conditions of declining fertility, the optimal estimate of current fertility is obtained by multiplying the fertility schedule by the P/F ratio applicable at the mean age of childbearing. The latter is obtained by interpolation between the relevant values of Table 3.15. The scaling factors shown in Table 3.16 apply.

Table 3.16 Mean of the fertility schedule and Feeney's scaling factor, by population group

	Africans	*Coloureds*	*Asians/Indians*	*Whites*
Mean age of fertility schedule	28.8	27.6	28.6	28.9
Feeney's scaling factor	2.05	1.53	2.02	1.65

Multiplying the (shifted) fertility schedules by the factors shown in Table 3.16 gives rise to the age-specific fertility rates for each population group and total fertility applicable at the census date (Table 3.17).

Table 3.17 Adjusted estimates of age-specific fertility rates in South Africa from the 1996 census, by population group

Age group	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.086	0.068	0.024	0.019
20-24	0.159	0.144	0.120	0.089
25-29	0.159	0.133	0.185	0.151
30-34	0.135	0.097	0.085	0.088
35-39	0.102	0.060	0.045	0.031
40-44	0.050	0.023	0.023	0.016
45-49	0.007	0.002	0.008	0.010
TFR	**3.49**	**2.64**	**2.45**	**2.02**

The need for the adjustments described in the preceding sections suggest that the current fertility data in the census are of particularly poor quality, largely as a result of enumerator error. It is imperative that any analysis of the 1996 South Africa Census fertility data adjusts for the deficiencies outlined. Failure to do so results in seriously distorted estimates of current South African fertility. By contrast, the equivalent DHS data are of relatively good quality.

3.4 Lifetime and current fertility in South Africa in the late 1990s

This section compares the levels of lifetime and current fertility estimated from the adjusted census data and the 1998 South Africa Demographic and Health Survey (DHS). Section 3.4.1 presents data on mean children ever borne by population group, while Section 3.4.2 presents estimates of fertility by population group, and from these estimates of national fertility are derived.

3.4.1 Estimates of lifetime fertility by population group

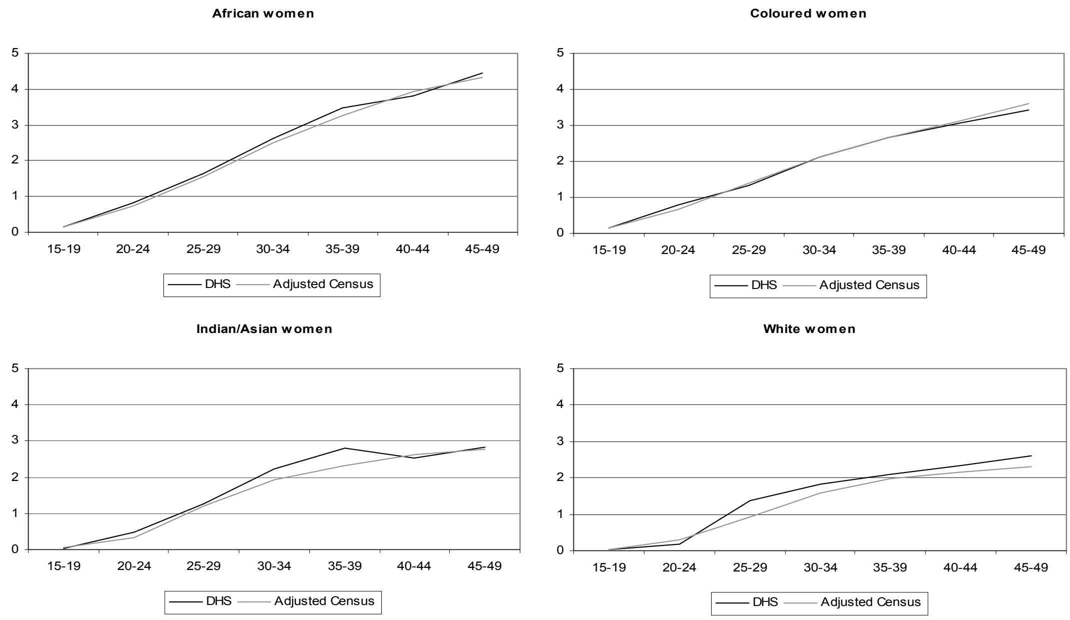
Table 3.18 shows the estimated mean children ever born to women, by population group and age group, using the (adjusted) 1996 census and the 1998 DHS data.

Table 3.18 Mean children ever borne, by age and population group, 1998 DHS and 1996 census

	Africans			*Coloureds*		
Age group	*Unadjusted census*	*Adjusted census*	*DHS*	*Unadjusted census*	*Adjusted census*	*DHS*
15-19	0.23	0.16	0.15	0.18	0.14	0.16
20-24	0.91	0.74	0.83	0.79	0.68	0.80
25-29	1.74	1.55	1.65	1.52	1.39	1.33
30-34	2.69	2.50	2.63	2.24	2.11	2.12
35-39	3.48	3.27	3.46	2.82	2.68	2.66
40-44	4.16	3.92	3.81	3.27	3.12	3.07
45-49	4.61	4.33	4.46	3.74	3.60	3.42
	Asians/Indians			*Whites*		
Age group	*Unadjusted census*	*Adjusted census*	*DHS*	*Unadjusted census*	*Adjusted census*	*DHS*
15-19	0.07	0.05	0.03	0.06	0.04	0.02
20-24	0.53	0.33	0.47	0.35	0.29	0.19
25-29	1.34	1.20	1.26	1.02	0.92	1.37
30-34	2.06	1.94	2.24	1.67	1.58	1.82
35-39	2.43	2.32	2.79	2.05	1.96	2.11
40-44	2.71	2.61	2.55	2.24	2.15	2.33
45-49	2.92	2.78	2.84	2.40	2.31	2.59

These data are shown in Figure 3.6. After application of the adjustments described above, the estimates for African and Coloured women from the census and the DHS correspond extremely well. The estimates of African women's lifetime fertility flatten out between ages 35 and 44 in the DHS. This further supports the idea suggested earlier that rural African women in the 40-44 age group tended to understate their ages in the DHS. For White and Asian/Indian women, the data sources agree less well. This is partially a function of the small samples of women in these two groups in the DHS.

Figure 3.6 Mean children ever borne, by age and population group, 1998 DHS and 1996 census



3.4.2 Age-specific fertility rates by population group

The estimated age-specific fertility rates arising from the census and the DHS are shown in Table 3.19. Fertility rates are calculated from the 1998 DHS using women's reported numbers of births in the three years before the survey, and calculating each woman's contribution to the total exposure to risk (in months) by age-group over the three years. The rates are directly comparable insofar as they refer to the same date. As a result of the Brass-Feeney correction made to the census data, the census rates reflect the level of fertility at the census date (i.e. October 1996). The rates calculated from the DHS data are based on births to women in the three years before the survey, and refer on average to a date 18 months before the DHS interviews. Thus, since almost 70 percent of the DHS interviews were conducted between February and April 1998, these rates also refer to October 1996.

The effect of the adjustments made to the census data is not apparent if one looks only at the estimated level of fertility. As a result of the corrections made to the census data, the age distributions of fertility in the adjusted and unadjusted census estimates are radically different.

Table 3.19 Age-specific fertility rates by population group

	Africans			Coloureds		
Age group	*Unadjusted census*	*Adjusted census*	*DHS*	*Unadjusted census*	*Adjusted census*	*DHS*
15-19	0.050	0.086	0.081	0.048	0.068	0.081
20-24	0.104	0.159	0.139	0.105	0.144	0.162
25-29	0.117	0.159	0.142	0.121	0.133	0.128
30-34	0.127	0.135	0.119	0.095	0.097	0.083
35-39	0.113	0.102	0.088	0.066	0.060	0.042
40-44	0.096	0.050	0.038	0.050	0.023	0.010
45-49	0.080	0.007	0.013	0.035	0.002	0.001
TFR	**3.44**	**3.49**	**3.11**	**2.60**	**2.64**	**2.53**

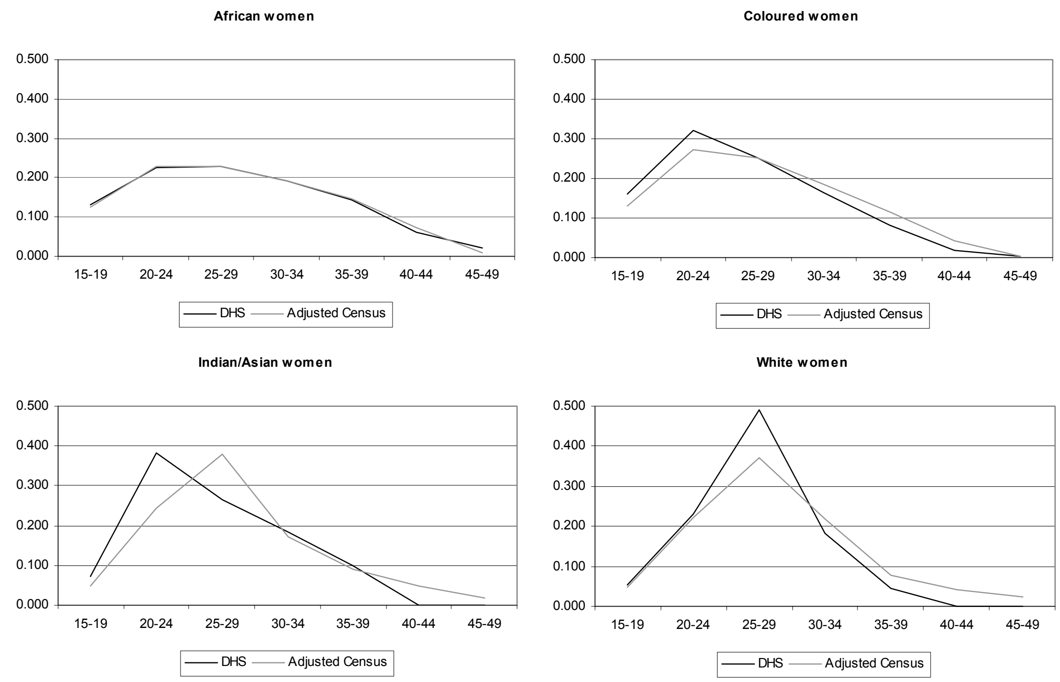
	Asians/Indians			Whites		
Age group	*Unadjusted census*	*Adjusted census*	*DHS*	*Unadjusted census*	*Adjusted census*	*DHS*
15-19	0.013	0.024	0.026	0.013	0.019	0.020
20-24	0.087	0.120	0.138	0.063	0.089	0.087
25-29	0.112	0.185	0.095	0.110	0.151	0.185
30-34	0.086	0.085	0.066	0.082	0.088	0.069
35-39	0.048	0.045	0.036	0.046	0.031	0.016
40-44	0.035	0.023	0.000	0.035	0.016	0.000
45-49	0.035	0.008	0.000	0.033	0.010	0.000
TFR	**2.09**	**2.45**	**1.80**	**1.91**	**2.02**	**1.88**

The adjusted level of fertility estimated from the census data is higher than that indicated by the DHS, particularly for African women. However, the estimates of Asian/Indian (and, to a lesser extent, White) fertility from the DHS are based on a sample too small to be reliable. (The preliminary report issued by the Department of Health (1999), did not even publish an estimated total fertility rate for Asian/Indian women for this reason.)

The standardised fertility distributions (i.e. assuming a TFR of 1) differ markedly by population group, with those for African and Coloured women being relatively flat, and those for Asians/Indians and Whites being far more concentrated around the mode (Figure 3.7). The standardised distributions of fertility for African women are almost identical in the DHS and the adjusted census results. Minor differences exist for the 40-44 age group, as one would expect if, as suspected, the misstatement of age by rural women in this age group occurred in the DHS. The flatness of the fertility distribution at younger ages (and the high rate of fertility among adolescents) for African women is similar to a pattern identified in rural Northern Province by Garenne, Tollman and Kahn (2000), which they discovered to be the result of two components of similar magnitude: high levels of premarital fertility among women aged 15 to 25, and marital fertility among women aged 15 to 49.

The shape of the fertility distribution for Coloured women differs quite substantially between the two data sets. DHS fieldworkers experienced difficulty in adequately surveying the population of the Western Cape, where the majority of the Coloured population lives, and this would account for the difference. The fertility schedules for Indian/Asian women differ between the DHS and the census. Although the mode of the DHS fertility distribution seems to be too low, this probably reflects the small sample size. The fertility schedule for White women has the same shape in both DHS and census; although the higher peak in the 25-29 age group in the DHS simply reflects the fact that no White women over the age of 40 reported births in the three years before the survey.

Figure 3.7 Percent distribution of fertility according to age by population group



3.4.3 National age-specific fertility rates

Two approaches could be adopted for the calculation of national South African age-specific fertility rates from the census data. The first is to use the national data (i.e. not disaggregated by population group) from the census, and apply adjustments to it of the form set out in Section 3.3. The second approach is to weight the age- and population group-specific estimated fertility rates presented above to give an estimated national schedule of fertility rates. The second method is preferable to the first. There is strong heterogeneity in the fertility schedules by population group presented in Table 3.19, in terms of both their level and their shape. Moreover, not all the adjustments made to the data on African women are applicable to the data on minority population groups (for example, the correction in respect of stillbirths and the Relational Gompertz model for Whites and Indians/Asians).

3.4.3.1 Weights used to calculate national age-specific fertility rates

Thus, suitable weights are required to estimate the national age-specific fertility rates. Since the intention is to first calculate age-specific rates, and thence the total fertility rate, the weights chosen for use with the census estimates are the distributions of women, by population and age group, excluding those women whose population group was not stated (Table 3.20).

Table 3.20 Weights used in the estimation of national age-specific fertility rates from the 1996 census

Age group	*Africans*	*Coloureds*	*Indians/Asians*	*Whites*
15-19	0.815	0.083	0.023	0.078
20-24	0.803	0.086	0.026	0.086
25-29	0.777	0.094	0.027	0.102
30-34	0.765	0.100	0.028	0.107
35-39	0.741	0.100	0.030	0.128
40-44	0.720	0.099	0.034	0.147
45-49	0.689	0.101	0.037	0.173

Note: Weights may not sum to 1 by age owing to rounding.

No such problem arises with the DHS data. First, no adjustments of the magnitude required for the census data were needed. Second, the method of calculating the age-specific fertility rates from the DHS data was based on the precise calculation of exposure-to-risk, and hence, the calculation of national rates direct from the data produces the same results if the population-group specific fertility rates from the DHS had been weighted by their contribution to the exposure to risk (Table 3.21).

Table 3.21 Weights used in the estimation of national age-specific fertility rates from the 1998 DHS

Age group	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.819	0.094	0.028	0.059
20-24	0.838	0.090	0.028	0.044
25-29	0.777	0.115	0.031	0.078
30-34	0.770	0.111	0.043	0.076
35-39	0.751	0.114	0.035	0.100
40-44	0.738	0.101	0.044	0.116
45-49	0.703	0.113	0.051	0.133

The final estimates of the national age-specific fertility rates are shown below.

Table 3.22 National age-specific fertility estimates, 1998 DHS and 1996 census

Age group	*15-19*	*20-24*	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	***TFR***
Census	0.078	0.151	0.156	0.125	0.087	0.042	0.007	**3.23**
DHS	0.076	0.139	0.142	0.109	0.074	0.029	0.009	**2.89**

The revised census estimates show higher fertility than the DHS in all cohorts other than the oldest, and markedly higher fertility in the 40-44 age group. Again, this provides evidence that older women's age reporting in the DHS was flawed and subject to misreporting. Based on the earlier discussions of the quality of the data in each survey, and the limited data in the DHS relating to minority population groups, it is probable that the DHS is not capable of providing wholly reliable estimates of national fertility, and even less so of the level of fertility in the minority population groups.

3.4.4 Provincial fertility estimates from the revised census and DHS data

Apartheid policies on urbanisation, and the creation of the so-called 'homelands' have created wide provincial disparities in health, education and socio-economic markers, as well as the racial composition of each province. These differentials translate into widely disparate levels of fertility across the country. Provincial estimates of fertility using the adjusted census data and the DHS are shown in Table 3.23 below. Unlike the national estimates, the provincial estimates are not calculated from a weighted average of estimated fertility for each population group in the province, as the number of observations in the DHS data (required to make the correction in respect of inclusion of stillbirths) precludes analysis by population group and province simultaneously.

While in all provinces the level of fertility shown by the adjusted census data is lower than that shown by the DHS, there is a good correspondence between total fertility estimated from the census and the DHS, except in the Eastern Cape, Free State, North-West and Mpumalanga. The rankings of provinces by their total fertility, according to the two inquiries, are in reasonably good agreement.

Table 3.23 Estimates of age-specific fertility by province of usual residence, 1996 census and 1998 DHS

	Western Cape		*Eastern Cape*		*Northern Cape*	
Age group	*Census*	*DHS*	*Census*	*DHS*	*Census*	*DHS*
15-19	0.055	0.067	0.079	0.079	0.071	0.076
20-24	0.131	0.120	0.170	0.146	0.155	0.156
25-29	0.122	0.121	0.178	0.175	0.143	0.148
30-34	0.088	0.092	0.154	0.141	0.105	0.092
35-39	0.053	0.051	0.116	0.107	0.064	0.044
40-44	0.019	0.007	0.056	0.037	0.024	0.015
45-49	0.002	0.000	0.008	0.008	0.002	0.005
TFR	**2.35**	**2.29**	**3.80**	**3.47**	**2.82**	**2.68**

	Free State		*KwaZulu-Natal*		*North-West*	
Age group	*Census*	*DHS*	*Census*	*DHS*	*Census*	*DHS*
15-19	0.060	0.055	0.078	0.092	0.076	0.060
20-24	0.147	0.103	0.157	0.148	0.151	0.137
25-29	0.142	0.116	0.157	0.158	0.145	0.091
30-34	0.107	0.094	0.130	0.109	0.114	0.108
35-39	0.067	0.043	0.094	0.098	0.078	0.076
40-44	0.025	0.027	0.043	0.042	0.033	0.016
45-49	0.002	0.000	0.006	0.019	0.004	0.000
TFR	**2.75**	**2.19**	**3.32**	**3.33**	**3.00**	**2.44**

	Gauteng		*Mpumalanga*		*Northern Province*	
Age group	*Census*	*DHS*	*Census*	*DHS*	*Census*	*DHS*
15-19	0.059	0.052	0.093	0.100	0.101	0.090
20-24	0.131	0.125	0.170	0.129	0.181	0.179
25-29	0.126	0.136	0.161	0.124	0.180	0.187
30-34	0.096	0.084	0.128	0.136	0.154	0.142
35-39	0.062	0.047	0.089	0.097	0.118	0.089
40-44	0.024	0.024	0.039	0.015	0.059	0.059
45-49	0.003	0.000	0.005	0.016	0.009	0.029
TFR	**2.50**	**2.34**	**3.42**	**3.09**	**4.01**	**3.88**

3.5 Retrospective estimates of fertility using reverse-survival methods

Using the data from the 1996 and 1970 South Africa Censuses, reverse-survival techniques can be applied to the data for all South African women, and for African South African women separately, to better understand the trends in South African fertility over the last fifty years and place the results derived above in an historical context.

3.5.1 All South African women

With appropriate assumptions (the most important of which is the requirement that no differential under-enumeration has occurred in particular age groups in the data being analysed), reverse-survival techniques can provide valuable insights into fertility trends for periods up to 15 years before a census or survey (Bogue, 1993). The method is intuitively simple: if the level of mortality by age for the 15 years prior to the survey or census can be estimated accurately, it is possible to estimate the number of births that must have occurred in earlier years to give rise to the current population. Using estimates of South African mortality derived by Timæus, Dorrington, Bradshaw and Nannan (forthcoming), total fertility rates for the period from 1981 to 1996 can be derived from the 1996 census data. A similar exercise was performed using the data from the 1970 South Africa Census, using the Princeton Regional Model Life Tables (Coale, Demeny and Vaughan, 1983) to estimate mortality[4]. Using a schedule of the fertility distribution in quinquennial groups to apportion the births by age of mother, estimates of the age-specific fertility rates for each of the 15 years preceding the survey, and hence estimates of total fertility, can be derived. The fertility distributions needed to do this for the period 1981 to 1996 were interpolated from the estimated fertility in 1996 (Table 3.22), and data for 1978 (South Africa, 1983:115).

The reverse-survival estimates of fertility calculated using the 1970 census data are more approximate, not only in their use of model life tables, but also because no published data on the distribution of fertility by age exist for this period. Estimates of the racial composition of South Africa for the period 1955-1970 were derived by interpolating between those published estimates that are available for 1960 and 1970 (South Africa, 1983:12). Sadie's (1973) estimates of fertility by population group and period were then combined using these weights and interpolation between them was used to derive annual national fertility schedules. Annual fertility schedules for Africans were interpolated directly between Sadie's estimates. Schedules for the first and last periods of each reverse-survival projection, for South Africans and African South Africans separately, are shown in Table 3.24.

[4] The reverse-survival estimates of fertility for this period was calculated on three different bases using the West Regional Life Tables: A fast mortality decline scenario used Level 11 for 1955-60, Level 13 for 1960-65 and Level 15 for 1965-70. A medium mortality decline scenario (shown in the graphs) used Levels 12, 13 and 15 for the same time periods, while a slow mortality decline scenario used Levels 13,14 and 15. The general level of mortality was chosen so that the resulting tables showed values of e_0 and ${}_5q_0$ roughly in line with estimates for the population at the time.

Table 3.24 Distributions by age of fertility used in the reverse-survival projections

	1956		*1970*		*1982*		*1996*	
Age group	*All*	*Africans*	*All*	*Africans*	*All*	*Africans*	*All*	*Africans*
15-19	0.053	0.045	0.061	0.056	0.074	0.078	0.102	0.123
20-24	0.213	0.190	0.228	0.212	0.234	0.218	0.227	0.227
25-29	0.233	0.220	0.251	0.241	0.261	0.240	0.244	0.228
30-34	0.195	0.198	0.203	0.207	0.199	0.200	0.199	0.193
35-39	0.156	0.167	0.143	0.153	0.133	0.148	0.140	0.146
40-44	0.096	0.111	0.075	0.084	0.069	0.080	0.072	0.072
45-49	0.054	0.069	0.040	0.048	0.030	0.037	0.015	0.010

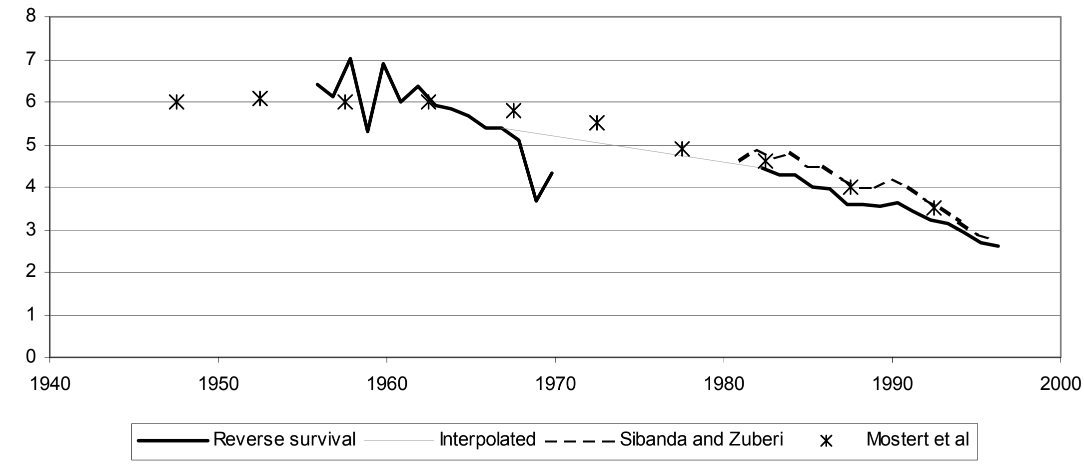
Source: Derived from Sadie (1973), South Africa (1983), and Table 3.19 (Africans) and Table 3.22 (All)

The estimates derived from the application of the reverse-survival technique are shown in Figure 3.8, together with estimates published by Mostert, Hofmeyr, Oosthuizen *et al.* (1998) and Sibanda and Zuberi (1999). The former are those presented in Table 2.1, while the latter are historic estimates of South African fertility derived from the 1996 census data, also using reverse-survival techniques. These estimates, however, are based on complex (and inadequately documented) algorithmic procedures that attempt to link data on children to their mothers.

The absence of reliable census data for South Africa between 1970 and 1996 creates a gap in our knowledge relating to the period 1970-1981. However, linear interpolation between the two series[5] allows some tentative conclusions to be drawn and enhances our understanding of the trend in South African fertility over the fifty years since 1948.

Figure 3.8 Trends in total fertility, all South African women, 1948-1996

[5] To avoid errors associated with misreporting of infants' age and under-enumeration at the youngest ages, interpolated results using the values for 1966 and 1983 have been calculated.



Source: Own calculation; Mostert, Hofmeyr, Oosthuizen *et al*. (1998); Sibanda and Zuberi (1999)

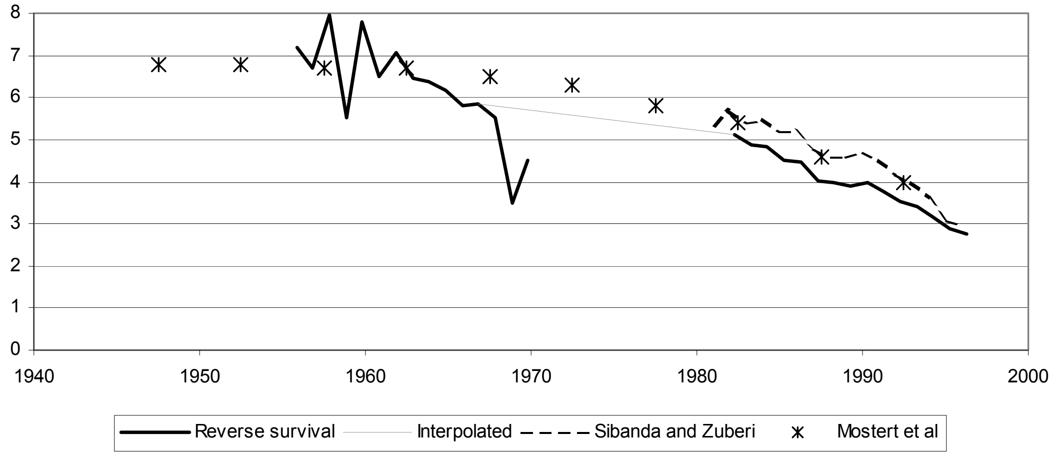
The deficiencies of the data and the limitations of the methodologies applied notwithstanding, Figure 3.8 indicates that – especially for more recent time periods – the resulting estimates of past South African fertility are generally consistent with those of other demographers, and provides some support for the use of the reverse-survival approach. The estimates derived for the 1950s and 1960s are indeed rough approximations as the variability in fertility estimates from one year to the next indicates. The very low levels of fertility estimated for 1968 and 1969 reflect the underenumeration of children under the age of 2 in the 1970 census, while the pattern in the later years of the 1950s shows strong digit preference.

From the above, we can conclude that the pace of decline of fertility in South Africa has been slow and gradual since the 1960s. There are no obvious changes in the trend associated with the implementation of the government's family planning programmes in either 1974 or 1984. The next section examines the history of the fertility decline among African South African women.

3.5.2 African women

Applying the same reverse-survival techniques to the African population produces the results shown in Figure 3.9. Given the racial composition of the South African population, it is not surprising that the trends shown in Figure 3.8 and Figure 3.9 are very similar.

Figure 3.9 Trends in total fertility, African South African women, 1948-1996



Source: Own calculation; Mostert, Hofmeyr, Oosthuizen *et al*. (1998); Sibanda and Zuberi (1999)

The two back projections (and the interpolation between them) show clearly that the decline in African women's fertility began (at the latest) in the early 1960s. Fertility only fell slowly over the following decade. Since the early 1990s, fertility has declined at a faster pace again with little discernible effect of the national family planning programmes on the pace of the fertility decline. While the pattern shown by the estimates based on reverse-survival techniques is broadly similar to those shown by other estimates, some features are worthy of additional comment.

First, the estimates are lower than those produced by Sibanda and Zuberi, especially for the period 1982 to 1994. This difference is most probably attributable to their inadvertent linking of children to their grandmothers (not their mothers), and hence inflating estimates of fertility among older women. This can be demonstrated through a comparison of the (standardised to 1) age-specific fertility rates presented above for Africans, and those presented by Sibanda and Zuberi. Table 3.25 shows that Sibanda and Zuberi found lower fertility at younger ages than those estimated above, and significantly higher fertility after age 40.

Table 3.25 Comparison of standardised age-specific fertility rates for Africans in 1996 derived from the adjusted census data, and those derived by Sibanda and Zuberi

Age group	*Adjusted census data*	*Sibanda and Zuberi*
15-19	24.6	16.7
20-24	45.6	36.1
25-29	45.6	42.5
30-34	38.7	43.8
35-39	29.2	33.1
40-44	14.3	18.7
45-49	2.0	9.0

Source: Table 3.19 (adjusted census estimates), Sibanda and Zuberi (1999).

Second, both reverse-survival techniques produce estimates of recent fertility that are substantially lower than those indicated by the estimation from current fertility data. This suggests that despite the corrections made in the post-enumeration survey, there was a significant undercount of young children in the 1996 census.

3.5.3 Undercount of infants and children under 5 in the 1996 census

Dorrington (1999) has suggested that, as in other South African censuses, a systematic undercount of infants and children less than 5 years of age occurred in the 1996 census. Mostert, van Tonder and Hofmeyr (1987), in a reconstruction of the African South African population, estimated that children under the age of five had been underenumerated in earlier censuses to the extent shown in Table 3.26.

Table 3.26 Percent undercount of African South African children (0-4) by sex, various years

	Census Year		
Sex	*1936*	*1970*	*1980*
Males	15.8	26.9	38.0
Females	9.2	23.8	37.2

Source: Mostert, van Tonder and Hofmeyr (1987)

The undercount of children under the age of 5 in the 1996 South Africa Census was probably not as high as in the 1980 census. However, dividing the estimate of total fertility in 1996 from the current fertility data in the census by that from the reverse-survival procedure suggests that the undercount of infants (aged less than one) in the 1996 census was 22.9 percent. For African infants, the equivalent estimate is 26.6 percent.

3.6 Cohort-period fertility

Cohort-period fertility rates measure the fertility of a cohort of women (usually grouped into quinquennial age groups) in a defined period (usually grouped in five year periods before the survey). Using cohort-period fertility rates to analyse birth history data from surveys such as the DHS is preferable to using conventional age-period rates because the calculations are simple; one can readily sum the rates to obtain measures that represent the experience of real cohorts of women; and because they allow direct calculation of P/F ratios. Cohort-period rates and P/F ratios, calculated following the procedure set out in Goldman and Hobcraft (1982), are presented in Table 3.27.

Panel A shows the number of women in each age group at the time of the survey, and the reported number of births to women in each age group, grouped by time before the survey. Thus, for example, after weighting, between 1989 and 1993 1056.6 births occurred to the 1435.8 women who were aged 25-29 at the time of the survey.

Panel B presents the annual cohort-period fertility rates, derived by dividing the number of births to each cohort of women in a given time period before the survey by the number of women in that age group at the time of the survey, and dividing the result again by 5 to give the annual rate. Reading across the rows in Panel C (from right to left) indicates how fertility has changed over time for women of the same age, while Panel E provides equivalent data cumulated by age. The results confirm those of the reverse-survival analysis. While fertility has been falling for many years, the pace of fertility decline has accelerated in the ten years before the DHS (i.e. since 1988).

Reading up a diagonal in Panel D from left to right shows the cumulative fertility of a cohort at five-yearly intervals (i.e. of that cohort at younger ages). Reading across the rows shows the cumulative fertility of different cohorts of women by the same age. The data on the diagonal associated with the cohort of women aged 40-44 are inconsistent with the data for adjacent cohorts, since the cumulative fertility of this cohort at younger ages is lower than the cumulative fertility of the 35-39 cohort at the same ages. This could result from displacement of births from more distant to more recent periods for women in that cohort (i.e. Potter (1977) effects). The investigations discussed earlier, however, suggest that it is the age reporting of women in that cohort that is at fault, not imperfect recall of past fertility by women in one specific cohort.

Table 3.27 Cohort-period fertility rates and P/F ratios, African women

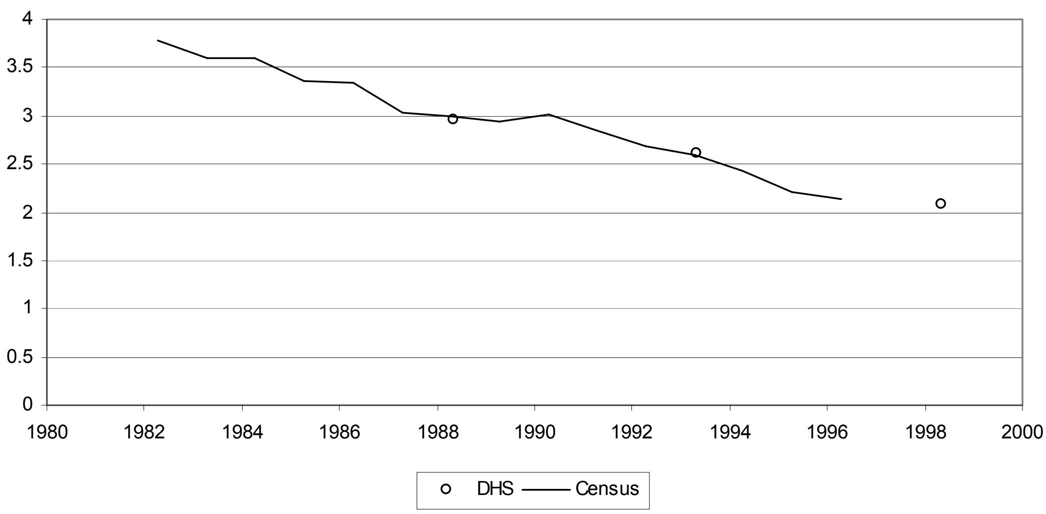
			Years prior to survey					
			0-4	*5-9*	*10-14*	*15-19*	*20-24*	*25-29*
	Age group of cohort at survey							
A		**No. WOMEN**	**NUMBER OF BIRTHS**					
	15-19	1771.746	266.001	3.184				
	20-24	1716.206	1055.096	356.955	9.679			
	25-29	1435.828	991.502	1056.621	314.643	16.494		
	30-34	1235.566	783.452	1053.272	1086.243	334.444	9.873	
	35-39	1215.648	621.143	981.586	1227.718	1052.915	328.473	16.015
	40-44	941.870	291.786	621.853	801.306	887.200	796.458	195.943
	45-49	676.136	86.741	284.848	540.161	602.667	768.016	595.601
B	**COHORT PERIOD FERTILITY RATES**							
	15-19		0.030	0.000				
	20-24		0.123	0.042	0.001			
	25-29		0.138	0.147	0.044	0.002		
	30-34		0.127	0.170	0.176	0.054	0.002	
	35-39		0.102	0.161	0.202	0.173	0.054	0.003
	40-44		0.062	0.132	0.170	0.188	0.169	0.042
	45-49		0.026	0.084	0.160	0.178	0.227	0.176
	Age group of cohort at end of period							
C	**COHORT PERIOD FERTILITY RATES**							
	15-19		0.030	0.042	0.044	0.054	0.054	0.042
	20-24		0.123	0.147	0.176	0.173	0.169	0.176
	25-29		0.138	0.170	0.202	0.188	0.227	
	30-34		0.127	0.161	0.170	0.178		
	35-39		0.102	0.132	0.160			
	40-44		0.062	0.084				
	45-49		0.026					
D	**CUMULATIVE FERTILITY OF COHORTS AT END OF PERIOD (P)**							
	15-19		0.150	0.208	0.219	0.271	0.270	0.208
	20-24		0.823	0.955	1.150	1.136	1.054	1.094
	25-29		1.646	2.002	2.146	1.996	2.230	
	30-34		2.636	2.954	2.846	3.121		
	35-39		3.465	3.507	3.920			
	40-44		3.816	4.341				
	45-49		4.470					
E	**CUMULATIVE FERTILITY WITHIN PERIODS (F)**							
	15-19		0.150	0.208	0.219	0.271	0.270	0.208
	20-24		0.765	0.944	1.098	1.137	1.116	1.089
	25-29		1.455	1.796	2.108	2.079	2.252	
	30-34		2.090	2.604	2.959	2.970		
	35-39		2.601	3.264	3.758			
	40-44		2.910	3.685				
	45-49		3.039					
F	**P / F RATIOS**							
	20-24		1.076	1.012	1.047	1.000	0.944	1.005
	25-29		1.131	1.115	1.018	0.960	0.990	
	30-34		1.262	1.134	0.962	1.051		
	35-39		1.332	1.074	1.043			
	40-44		1.311	1.178				
	45-49		1.471					

Data errors are identifiable if the ratios in a given cohort deviate markedly from the trend in surrounding cohorts. The 40-44 cohort has low rates in every period. The absence of similar errors in the 35-39 or 45-49 cohort lends further weight to the conclusion that the 1998 DHS data for this age-group are distorted by rural women aged 40-44 reporting their age as 35-39.

Finally, Panel F presents P/F ratios derived by dividing the age- and period-specific rates in Panel D, by those in Panel E. The ratios compare lifetime fertility with current fertility and are a check on the quality of the data. Were the data to be perfect and fertility unchanging, the ratios would be very close to unity at all ages in all periods. However, increasing ratios point to declining fertility, and as such, deviations from unity allow the identification of the approximate time period in which fertility started declining (Centre for Population Studies, n.d.). The strongly upward trend in P/F ratios in the most recent time periods (0-9 years before the survey) again provides evidence of an acceleration in the decline in South African fertility, as these trends are not as readily discernible in earlier periods.

A further check on the comparability of the census and DHS data can be made by comparing the cumulative fertility of African women up to age 34. The census reverse-survival estimates of these women's fertility, and the appropriate cohort-period fertility rates from the DHS are shown in Figure 3.10.

Figure 3.10 Cumulative fertility of African women 15-34, 1982-1998



The remarkable agreement between the two earlier estimates from the DHS and the census-based series inspires confidence about the quality of the age distribution of African women in the census, the appropriateness of Timæus *et al*'s mortality estimates used in the reverse-survival calculations, as well as the quality of the enumeration of African children aged between 5 and 15. The more recent fertility estimates from the census seem a little low. This is further evidence that some underenumeration of young children and infants in the census occurred.

3.7 Conclusion

This chapter set out to provide estimates of the current level of fertility in South Africa, and among African South Africans particularly, using recently collected data. The quality of these data in the country has been investigated in greater detail than ever before. The rigour with which the quality of the 1996 South Africa Census data has been assessed, and the close correspondence of the adjusted standardised estimates of fertility with the results from the 1998 DHS suggest that these results are, indeed, robust.

After substantial correction and modification, the data from the 1996 census provide more plausible estimates of current levels of fertility in the country and suggest that the fertility level among African South Africans in 1996 was approximately 3.5 children per woman. The level of fertility estimated from the 1998 DHS is somewhat lower. The adjustments made to the 1996 census data have the effect of first reducing the estimated level of fertility by approximately half while altering the shape of the fertility distribution fundamentally. The final adjustment (application of a P/F method) has the effect of restoring the level of estimated fertility to that calculated from the unadjusted data, although the age distribution is still completely different.

The principal reason for making these adjustments arises from the fact that the fertility estimates published by Statistics South Africa based on the 1996 census neither accommodated nor compensated for most of the data errors identified in this chapter. The 1996 census data is clearly of poor quality, but the estimates presented here are more plausible in terms of their shape (not showing as high levels of older age fertility), while reflecting levels consistent with those derived from other sources. In pursuing these investigations, it is believed that the best estimates of the current level of fertility in Sa based on the 1996 census have been derived.

The estimates of past levels of fertility in South Africa are not as good as those of current levels. Estimates of South African fertility in the distant past are compromised by the poor quality of the 1970 census data. Nevertheless, these (along with those produced by Sibanda and Zuberi) provide independent estimates (i.e. not derived by government demographers) of the past trend in South African fertility.

In any event, a decline in the fertility of African South Africans is apparent from the early 1960s. Thus, South Africa entered the fertility transition several decades ahead of other countries in sub-Saharan Africa, most of which began to show a decline in fertility only in the 1980s. At the same time, fertility among African South Africans has fallen slowly – from approximately 6 children per woman in 1970, to around 3.5 a quarter of a century later. As shown in Chapter 2, some other countries in sub-Saharan Africa have shown a faster pace of decline once their fertility declines began. The reverse-survival estimates of past trends in African fertility in the country further suggest that the widely praised family planning programmes implemented by apartheid governments in 1974 and 1984 had no immediate effect on the pace of the fertility decline among African South Africans. This is not to suggest that the programmes were entirely ineffective: as the evidence presented in the following chapters will demonstrate, African women in South Africa made use of the family planning services offered, but not to effect a sudden or rapid change in their fertility. However, the unavailability of further demographic data to assess the trend in South African fertility over the 1970s does not permit a more conclusive identification of the trend in fertility around the time of the implementation of those programmes.

The relatively slow pace of the decline of fertility in South Africa is further highlighted by Bongaarts and Watkins' review of the correlation between development and fertility decline (Bongaarts and Watkins, 1996). They estimate that the fertility levels in the developing world declined by 36 percent between 1960-65 and 1985-90. Fertility in Asia and Latin America fell by 42 and 43 percent respectively. Although fertility decline in sub-Saharan Africa was "almost non-existent", according to the official estimates cited in Table 2.1, fertility in South Africa fell by 31 percent, slightly less than the international average. Despite the intense desire of successive apartheid governments for a rapid and sustained decline in African fertility and the vigorous family planning campaigns undertaken, fertility decline in South Africa was slow by international standards.

The final finding emerging from this chapter relates to the nature of the South African fertility decline. The age-specific fertility rates presented in Table 3.19 suggest that family size limitation is uncommon in South Africa. As Cohen (1993) has argued in relation to other African countries, the high levels of fertility among older women are incompatible with a desire for parity-specific fertility limitation:

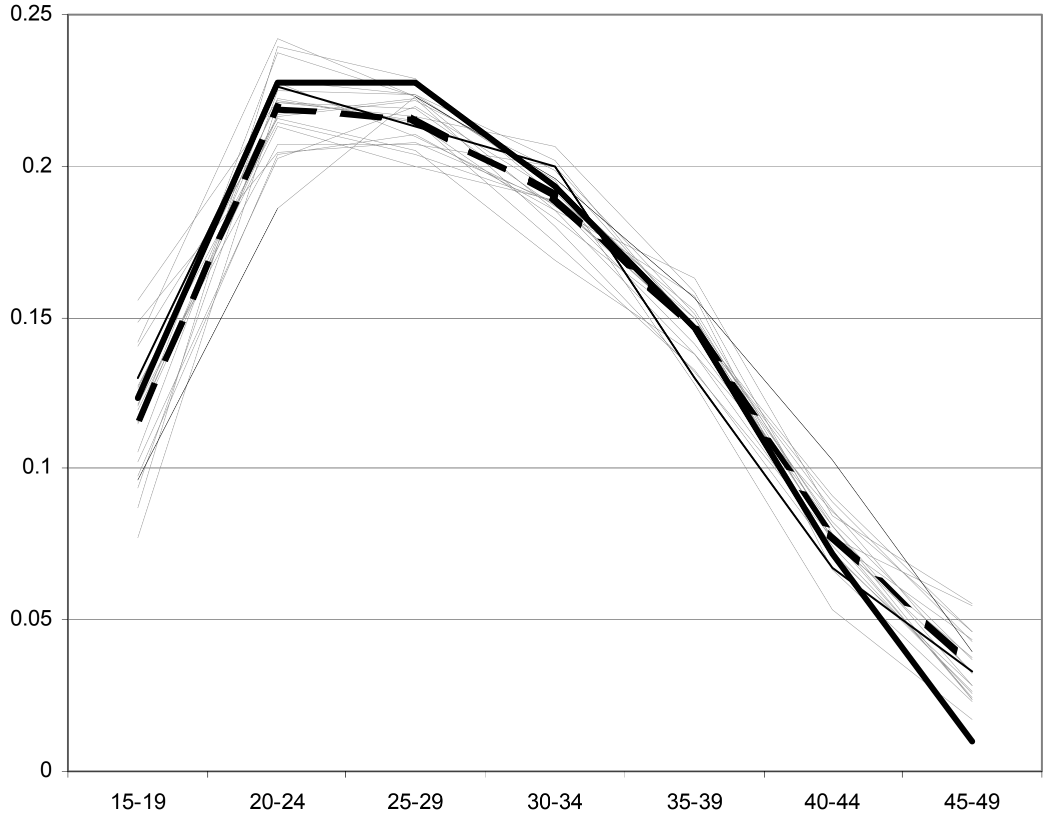
> Unlike Western populations, childbearing [in Africa] continues throughout a woman's reproductive years with no obvious "stopping" behaviour. The peak of childbearing occurs between 20 and 29 and falls slowly, indicating little parity-specific limitation. In societies that practice fertility limitation, fertility rates depart from a natural fertility schedule as women age, because women use efficient methods of contraception to prevent pregnancy once they have achieved their desired family size. There is little evidence of a stopping pattern in any of the fertility schedules for sub-Saharan Africa, despite the reported practice of terminal abstinence in some societies. (Cohen, 1993:30)

The data he uses to justify this assertion can be compared with those for African South Africans derived from the adjusted 1996 census results. Cohen provides estimates of age-specific fertility rates from DHS surveys conducted between 1984 and 1993 in 22 sub-Saharan African countries. Excluding the data from the unofficial 1987-9 South Africa DHS and from Burundi (a clear outlier), and standardising the fertility schedules so that the total fertility rate is equal to one in each case, produces the data presented in Figure 3.11.

The similarities in the fertility schedules are remarkable. Only at the extreme ages of childbearing does the fertility schedule for African South Africans differ noticeably from that of women in other African countries. As Cohen noted in relation to these other African countries, Figure 3.11 indicates that the mode of childbearing in South Africa also occurs between ages 20 and 29 (in fact, the schedule is constant between these ages). Between ages 30 and 44, there is no discernible difference between the standardised fertility schedules for South Africa and for those 21 other countries.

These results offer an ambiguous answer to the question of whether South Africa should be regarded as *sui generis* in the context of the African fertility transition. In terms of the trend in the level of fertility, South Africa is, according to the data presented in Figure 2.1, qualitatively different from other African countries. However, in terms of the age distribution of fertility, South Africa exhibits fundamental similarities not only with the countries that border it, but also with sub-Saharan African countries generally.

Figure 3.11 Standardised fertility schedules for 21 sub-Saharan African countries and South Africa (1996)



Note: The solid bold line represents the data for South Africa (1996). The broken bold line shows the unweighted average of the fertility schedules for 21 other African countries. Data for the other African countries are derived from Cohen (1993), excluding Burundi and South Africa 1987-9. Data for South Africa (1996) are derived from Table 3.19.

Several important questions have been raised in the process of deriving robust estimates of the current level of South African fertility. First, why did the South African fertility transition begin when it did? Second, why has the transition progressed so slowly? Third, what is the nature of the similarity between the processes of fertility transition in South Africa and in other sub-Saharan African countries? Answers to the first two questions are proposed in Chapters 5 and 6. These chapters situate the results derived here in the broader historiographical and institutional framework outlined in Section 2.4. A complete answer to the third question is impossible in this thesis, but further clues as to the nature and causes of the pattern of fertility decline in South Africa (and similarities and differences compared with other African countries) can be gained from investigations into parity progression and birth intervals. These are presented in the next chapter.

4 PARITY PROGRESSION AND BIRTH INTERVALS IN SOUTH AFRICA

This chapter investigates in greater detail the dynamics of the South African fertility decline set out in the preceding chapter. That chapter examined the current level of, and past trends in, African fertility in South Africa. This chapter presents analyses of the trends in childbearing and child spacing in South Africa. Two distinct approaches are adopted. The first examines the proportion of women who progress from one parity to the next (i.e. parity progression ratios and associated measures). The second approach investigates the length of time elapsed between one maternity and the next (i.e. the length of birth intervals).

4.1 Data requirements for the estimation of parity progression and birth intervals

The data requirements for most methods of investigating parity progression are fairly onerous. For the more advanced methods, detailed maternity history data giving the date of each birth to each woman in the survey are required. Consequently, the data collected in censuses are generally inadequate to the task. However, while this tends to limit the application of these techniques to data collected in demographic surveys such as that conducted in 1998, our understanding of the dynamics of parity progression and birth intervals in South Africa is enhanced with the use of data from the 1987-9 South Africa Demographic and Health Survey.

The international academic boycott of South Africa that was in place at the time meant that this survey does not form part of the international programme of surveys conducted with the assistance of the United States Agency for International Development (USAID) and Macro International Inc. However, the South African Human Sciences Research Council's survey used a questionnaire very similar to that used in the first round of DHS surveys. Almost 22 000 women of reproductive age, across all race groups, and across the entire country, including – importantly – the so-called "independent" and other homelands were interviewed.

The methodology underlying the survey and the quality of the data collected have been investigated in detail by Carol Kaufman (1997). In her assessment,

> in spite of methodological shortcomings and hazardous fieldwork conditions, careful analysis and presentation of results

> based on these data can provide useful and important information regarding the demographic processes of South Africans in the late 1980s … Responsible use of these data will provide important insights into the history of fertility processes, health conditions, and mortality in South Africa … (Kaufman, 1997:22)

For the purposes to which the data are applied here, the crucial limitation of the data from this survey is that the criteria for inclusion in the survey specified that women must either have been married, or have borne a child. Consequently, many, if not most, childless women were excluded from the survey, rendering impossible the investigation of entry into motherhood from these data. Notwithstanding this limitation, the data permit the analysis of trends in parity progression and childbearing among parous women over time, and it is on these trends that this chapter concentrates.

4.2 Measures of parity progression

This section presents three measures of parity progression. The first, the parity progression ratio, is presented in Section 4.2.1. This is not only the simplest measure of parity progression, but also it is the only measure that can be computed from data where no full maternity history has been collected, as is the case with census data. By contrast, the two other indices (Projected Parity Progression Ratios and Brass and Juárez' variant of the Censored Parity Progression Ratio method) derived in Sections 4.2.2 and 4.2.3 require detailed maternity histories.

4.2.1 Parity Progression Ratios (PPRs)

Parity Progression Ratios measure the proportion of women in a given cohort and of a given parity that has progressed to a specific parity. As such, the measure is generally only applied to women at the end of their childbearing years, as ratios for younger cohorts will be more strongly affected by changes in the timing of births, and will – in any event – represent incomplete maternity histories. Accordingly, the analysis below is restricted only to the oldest cohort of women for whom full data are available (i.e. women aged 45-49) in both the 1996 South Africa Census and the 1998 South Africa DHS.

Using the notation in Preston, Heuveline and Guillot (2001:104-5), W_i is defined as the number of women of parity *i*. The number of women of parity *i* or higher is denoted by P_{i} (= $\sum_{a=i}^{\infty} W_a$).

The parity progression ratio is then given by $PPR_{(i,i+1)} = P_{i+1} / P_i$.

A cumulative measure, the proportion of women in a cohort who have *i* children, is calculated by $PPR_{(0,i)} = P_i/P_0$. Summing this latter quantity over all parities, *i*, gives the average number of births to women in that cohort. Brass, Juárez and Scott (1997) describe the advantages of the parity progression ratio method thus:

> parity progression ratios for a cohort of women are simply a reorganisation of the distribution of completed family sizes at the end of the reproductive period. Unlike the traditional total fertility rates, these indices are not affected by the timing of births in the family build-up and hence by the transient effects of alterations in mating patterns. … [t]he estimation of precise measures is dependent on accurate reporting of total births but not on their location in time… (Brass, Juárez and Scott, 1997:83)

Parity progression ratios can be calculated from the 1996 census as well as both the 1987-9 and 1998 DHS data. The absence of any parity data precludes the calculation of parity progression ratios from the 1970 census data. The criteria for inclusion in the 1987-9 DHS mean that it is not possible to calculate accurate ratios for the progression from zero to first birth or, consequently, cumulative parity progression ratios. The calculation of PPRs from the 1998 DHS is straightforward, while the ratios derived from the 1996 census data are based on tabulations by parity and age after the application of the El-Badry adjustment, and after correcting for the inclusion of still-births.

Table 4.1 Parity progression ratios ($PPR_{(i,i+1)}$) and cumulated parity progression ratios ($PPR_{(0,i)}$) for African women aged 45-49, 1996 census, 1998 DHS and 1987-9 DHS

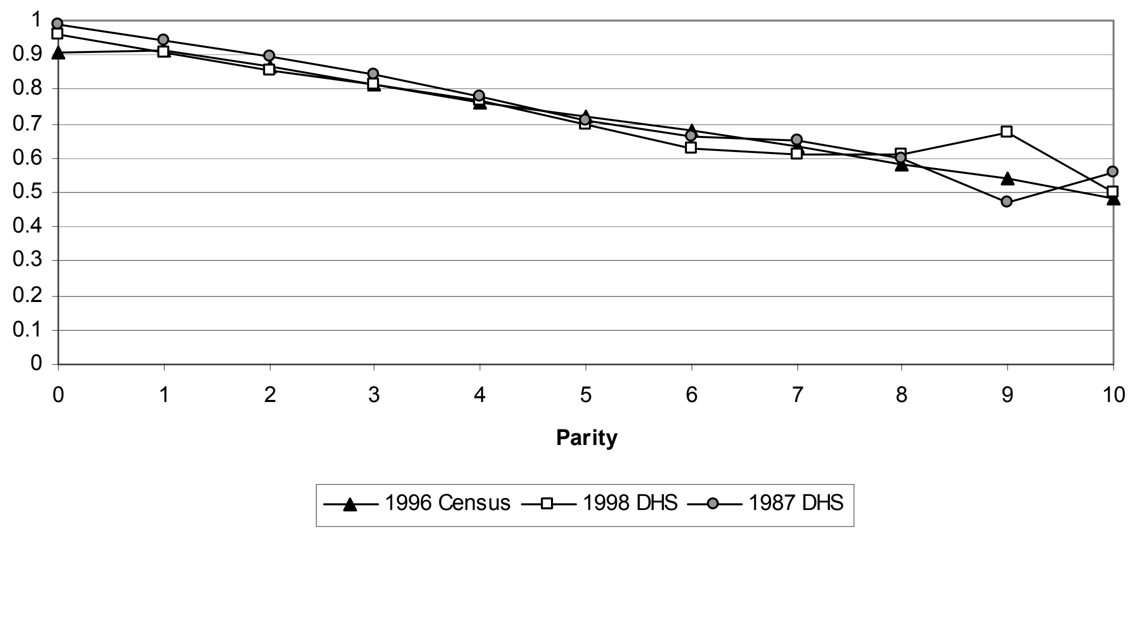
	1996 census		*1998 DHS*		*1987-9 DHS*
Parity (i)	$PPR_{(i,i+1)}$	$PPR_{(0,i)}$	$PPR_{(i,i+1)}$	$PPR_{(0,I)}$	$PPR_{(i,i+1)}$
0	0.922		0.959		(0.987)
1	0.924	0.922	0.906	0.959	0.941
2	0.872	0.852	0.855	0.869	0.896
3	0.820	0.743	0.813	0.743	0.845
4	0.767	0.609	0.766	0.605	0.781
5	0.729	0.467	0.697	0.463	0.710
6	0.687	0.341	0.626	0.323	0.661
7	0.642	0.234	0.608	0.202	0.651
8	0.588	0.150	0.609	0.123	0.601
9	0.545	0.088	0.672	0.075	0.471
10	0.478	0.048	0.501	0.050	0.558
11	0.525	0.021	0.430	0.025	0.357
12	0.483	0.011	0.825	0.011	0.213
13	0.509	0.005	0.338	0.009	0.505
14	0.551	0.003		0.003	

Table 4.1 presents the PPRs and cumulated parity progression ratios for women aged 45-49 in the 1996 census and the 1998 DHS. The final column gives the parity progression ratios calculated from the 1987-9 DHS.

Other than a slight difference at the lowest parities, in part a function of the magnitude of the El-Badry correction applied to the 1996 census data, the ratios from these data and the 1998 South Africa DHS correspond extremely well. In addition, these data show that the lifetime fertility of this cohort of African women in the late 1990s was somewhere between 4.33 children per woman (according to the 1996 census) and 4.46 children per woman (as shown by the DHS data).

Of greater significance though, is the strongly linear trend in the PPRs in both data sets, a pattern further confirmed by the data from the 1987-9 DHS (Figure 4.1). The fact that the ratios do not show any obvious 'steps' leads to the tentative conclusion that there is no socially sanctioned 'optimum number' of children among African South Africans. If there was, one would expect that the ratios would indicate that the vast majority of women would progress to that parity, and thereafter show a declining proportion of women progressing to higher parities. The pattern indicated by the ratios, on the other hand, suggests a process of increasing fertility control with higher parity, even in the 1987-9 DHS. Some women terminate their childbearing at relatively low parities. The probability of progressing to a further birth diminishes with each child born, and an ever-diminishing proportion of women progress to each subsequent parity.

Figure 4.1 Parity progression ratios ($PPR_{(i,i+1)}$) for African women aged 45-49, 1996 census, 1998 DHS and 1987-9 DHS



Furthermore, the absence of evidence relating to the operation of a socially sanctioned norm in the cohorts of women aged 45-49 in these three data sets suggests that such norms are unlikely to have existed in earlier cohorts.

PPRs for cohorts of younger women can be used to derive estimates of future parity progression ratios (discussed in the following section). In addition, these ratios are important in determining the reliability of calculated projected median birth intervals (presented in section 4.3.2). The tables below show the PPRs, by age group and parity, calculated from the two DHS surveys.

Table 4.2 Parity progression ratios by age group, 1998 DHS and 1987-9 DHS

1998 DHS					*Parity progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
15-19	0.142	0.051	0.246							
20-24	0.609	0.297	0.183	0.081						
25-29	0.840	0.586	0.428	0.337	0.360	0.301	0.146	0.604	0.500	1.000
30-34	0.945	0.802	0.631	0.562	0.401	0.473	0.382	0.227	0.493	0.000
35-39	0.961	0.876	0.776	0.698	0.613	0.559	0.449	0.428	0.371	0.457
40-44	0.958	0.880	0.829	0.741	0.704	0.595	0.485	0.514	0.568	0.599
45-49	0.959	0.906	0.855	0.813	0.766	0.697	0.626	0.608	0.609	0.672

1987-9 DHS					*Parity progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
15-19	..	0.097	0.319							
20-24	..	0.344	0.261	0.257						
25-29	..	0.623	0.497	0.412	0.324	0.414	0.352	0.171	0.566	0.617
30-34	..	0.798	0.706	0.611	0.552	0.513	0.388	0.451	0.423	0.237
35-39	..	0.912	0.816	0.739	0.669	0.590	0.525	0.507	0.504	0.360
40-44	..	0.949	0.861	0.830	0.776	0.690	0.637	0.599	0.566	0.522
45-49	..	0.941	0.896	0.845	0.781	0.710	0.661	0.651	0.601	0.471

Note: Data on parity progression to first birth from the 1987-9 DHS are not shown as a consequence of the criteria imposed for inclusion in that survey.

4.2.2 Projected parity progression ratios (P_i)

A more detailed measure of the evolution of African women's propensity to limit the size of their families is provided by the Projected Parity Progression Ratios (PPPRs) method, derived by Brass and Juárez (1983). These ratios, denoted P_i, are derived from the proportions of women in two contiguous cohorts (aged (x, $x+5$) and ($x+5$, $x+10$) respectively) with i children and who have had an $i+1^{th}$ child. The proportion for the older of the two cohorts is truncated by excluding births to women in that cohort in the immediately preceding five-year period. These truncated parity progression ratios are shown in Table 4.3. As a result of the truncation process, the experience of the older cohort is rendered comparable to that of the younger cohort, since they both refer to childbearing up to the same age. The method precludes the use of census data, since these cannot be manipulated to permit identification and exclusion of all children born to mothers in the five years before the census.

Table 4.3 Truncated parity progression ratios by age group, 1998 DHS and 1987-9 DHS

1998 DHS					*Parity progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
20-24(t)	0.200	0.066								
25-29(t)	0.654	0.342	0.274	0.290	0.249	0.153	0.500			
30-34(t)	0.889	0.691	0.504	0.416	0.344	0.303	0.218			
35-39(t)	0.935	0.843	0.730	0.618	0.518	0.434	0.320	0.389	0.053	0.000
40-44(t)	0.952	0.868	0.795	0.707	0.662	0.512	0.474	0.520	0.465	0.283
45-49(t)	0.959	0.902	0.857	0.786	0.757	0.682	0.619	0.557	0.637	0.674

1987-9 DHS					*Parity progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
20-24(t)	..	0.189								
25-29(t)	..	0.403	0.301	0.346	0.390	0.441	0.269			
30-34(t)	..	0.701	0.562	0.492	0.456	0.358	0.381			
35-39(t)	..	0.875	0.752	0.662	0.570	0.526	0.479	0.363	0.530	
40-44(t)	..	0.934	0.850	0.807	0.757	0.637	0.572	0.529	0.614	0.388
45-49(t)	..	0.936	0.890	0.836	0.770	0.703	0.660	0.636	0.547	0.471

Note: Data on parity progression to first birth from the 1987-9 DHS are not shown as a consequence of the criteria imposed for inclusion in that survey.

The ratio of these two proportions (that for the younger cohort divided by the that for the older (truncated) cohort) for each parity and cohort gives "indices of relative change", a measure of the change in fertility between the two equally truncated cohorts. An index less than one implies that the fertility of the younger cohort has fallen relative to the older cohort's fertility five years previously, and conversely.

These indices can then be chained to derive projected values of P_i, on the assumption that the relative speed at which women in each pair of cohorts progress to the next parity will differ by the same amount in the future as in the past. Starting with the value of P_i for the 45-49 cohort (which is also the projected P_i for that cohort), the projected P_i for the 40-44 cohort is derived by multiplying the projected P_i for the older cohort by the index of relative change between those cohorts, and similarly for each successively younger cohort. (Since the indices of relative change do not apply to the oldest cohort, the projected P_i for this cohort are identical to the parity progression ratios derived earlier). A comparison of the untruncated and truncated PPRs among older women confirms that the effect of truncation on the projected ratios is negligible (as would be expected, given that many of these women would have completed their childbearing), while the cohort differences in both the truncated and untruncated series are more substantial.

Table 4.4 shows, for example, that by the end of their childbearing years, 97.6 percent of African women aged 30-34 surveyed in the 1998 DHS are expected to have had a child. More important for future fertility trends in South Africa, the proportions of women who go on to bear children of higher parities are declining rapidly in comparison to the cohort of African women aged 45-49. While more than four-fifths of older women in the 1998 DHS with three children have progressed to a fourth birth, less than 70 percent of women aged 30-34 are expected to do so. Higher proportions in almost all combinations of age and parity are observed in the 1987-9 DHS.

Table 4.4 Projected parity progression ratios for African women, 1998 DHS and 1987-9 DHS

1998 DHS	*Parity Progression*									
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
20-24	0.858	0.624								
25-29	0.922	0.721	0.593	0.557	0.533					
30-34	0.976	0.850	0.697	0.688	0.509	0.723	0.554			
35-39	0.966	0.893	0.807	0.757	0.659	0.664	0.465	0.462	0.434	
40-44	0.958	0.884	0.827	0.766	0.712	0.608	0.490	0.561	0.544	0.598
45-49	0.959	0.906	0.855	0.813	0.766	0.697	0.626	0.608	0.609	0.672

1987-9 DHS	*Parity Progression*									
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
20-24	..	0.646								
25-29	..	0.756	0.690	0.593	0.479					
30-34	..	0.851	0.782	0.709	0.675	0.631	0.475			
35-39	..	0.932	0.832	0.768	0.696	0.646	0.586	0.587	0.511	
40-44	..	0.955	0.867	0.839	0.787	0.697	0.638	0.613	0.623	0.523
45-49	..	0.941	0.896	0.845	0.781	0.710	0.661	0.651	0.601	0.471

Note: The first column of projected parity progression ratios cannot be calculated with accuracy from the 1987-9 DHS as a consequence of the criteria applied for inclusion of women in that survey.

Other measures can also be derived from these projected parity progression ratios. The projected completed fertility of women in each cohort by the end of their childbearing years can be calculated from the 1998 DHS in a manner analogous to the calculation of cohort fertility rates from parity progression ratios described earlier (Table 4.5). Equivalent data for women surveyed in the 1987-9 DHS cannot be calculated for the reasons outlined earlier.

Table 4.5 Projected completed fertility of African women by cohort, 1998 DHS

Age group	*30-34*	*35-39*	*40-44*	*45-49*
	3.21	3.81	3.89	4.46

Thus, based on the 1998 DHS data and the assumptions underlying the method, African women aged 30-34 will have had, on average, 3.2 children by age 49, while women aged

40-44 will have had 3.9 children by the end of their childbearing years. As mentioned in Section 3.2.2, however, the estimates for women aged 35-39 are likely to have been biased upwards, and those for women aged 40-44 to be biased downwards, as a result of age misstatement of rural women aged 40-44.

4.2.3 Truncated pairwise measures of parity progression (B_t)

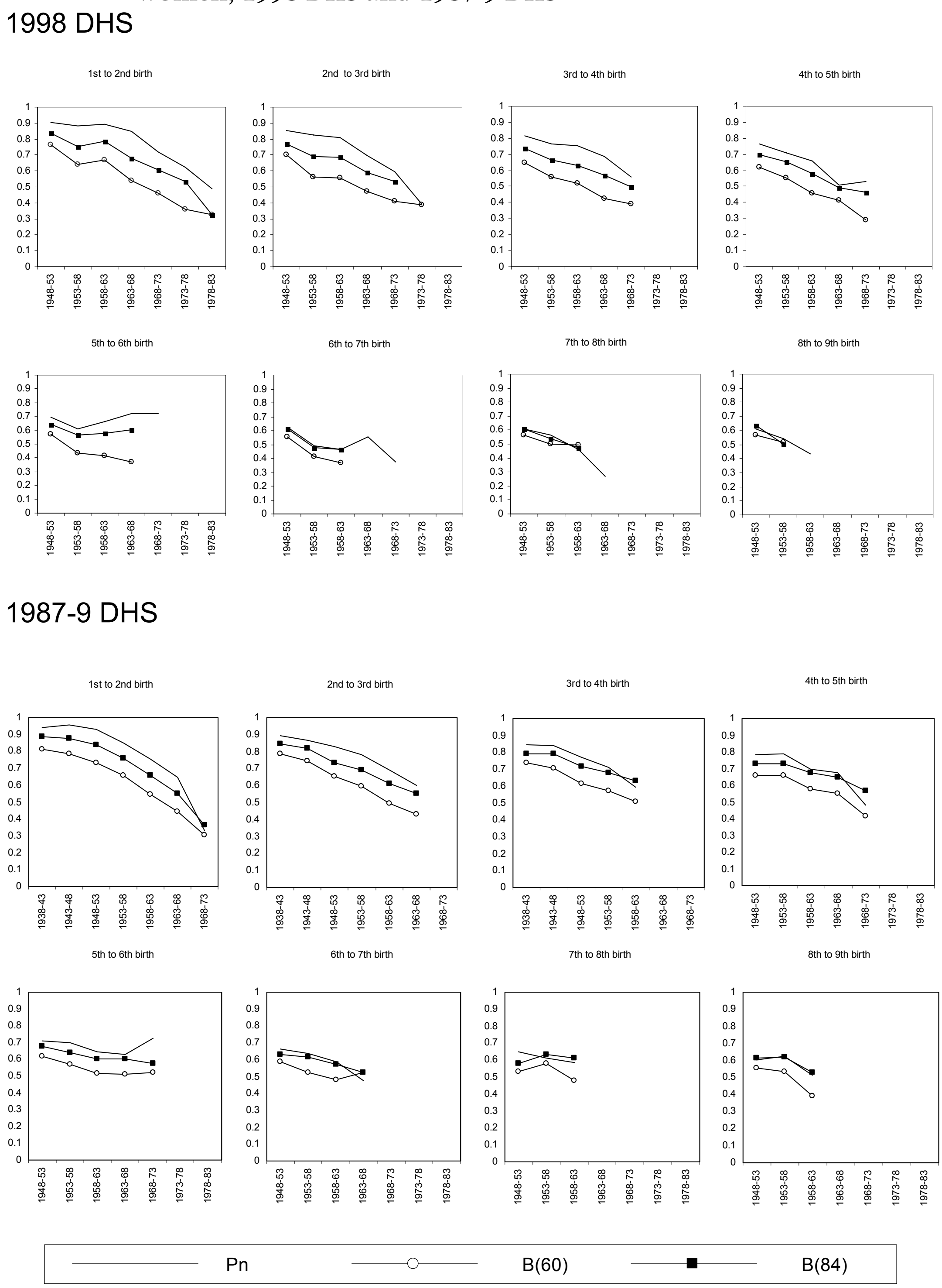
Before developing the simplified approach set out in the previous section, Brass and Juárez proposed another method to derive unbiased estimates of quantum changes in fertility, using life table techniques to deal more effectively with the problem of censoring. This method is a variant of that proposed by Rodríguez and Hobcraft (1980), but avoids the structural bias introduced in this latter approach arising from its systematic exclusion of women with long birth intervals.

The method uses the proportion (B_t) of women progressing to a subsequent parity within t months of the last birth. Adjusted B_ts are derived using a truncated pairwise comparison method, similar to that used to derive projected parity progression ratios. As with the P_is this truncation technique deals with the fact that "fast breeders" are more likely to move from one parity to the next at younger ages than "slow breeders." However, B_ts deal more carefully with the problem of censoring than the P_i method discussed above. The method is preferable since the P_i are biased if the distribution of exposure-to-risk of women is changing, while the use of life table methods standardises for this. In addition, use of this method also allows one to calculate median birth intervals, which cannot be done with the projected parity progression ratio approach.

Typically, a value of t is chosen so that the proportion of women ever progressing to a higher parity (i.e. the projected parity ratio, P_i) is close to the values of B_t. A value of 60 months (i.e. 5 years, and hence the term *quintum*, see Section 4.3.1) is frequently suggested as being long enough for most women who will ever do so to progress to a next birth, while avoiding the problem of increasingly sparse data when higher values of t are chosen.

In South Africa, the *mean* progression time from one birth to the next is in excess of 40 months for most age groups and parities. Accordingly, a value of t of much greater than 60 months is required to estimate parity progression. After examination of the data, and calculating adjusted B_t (using the same truncation approach as above) values, a more appropriate value of t was adopted of 84 months – thus allowing 7 years between births. Values of the adjusted B_t closer to the P_i could be achieved through use of B_{90}s, but the additional data loss is not justifiable. The values of P_i, B_{60}, and B_{84} calculated from the 1998 DHS and the 1987-9 DHS are shown in Figure 4.2.

Figure 4.2 Indices of parity progression by birth cohort and parity for African women, 1998 DHS and 1987-9 DHS

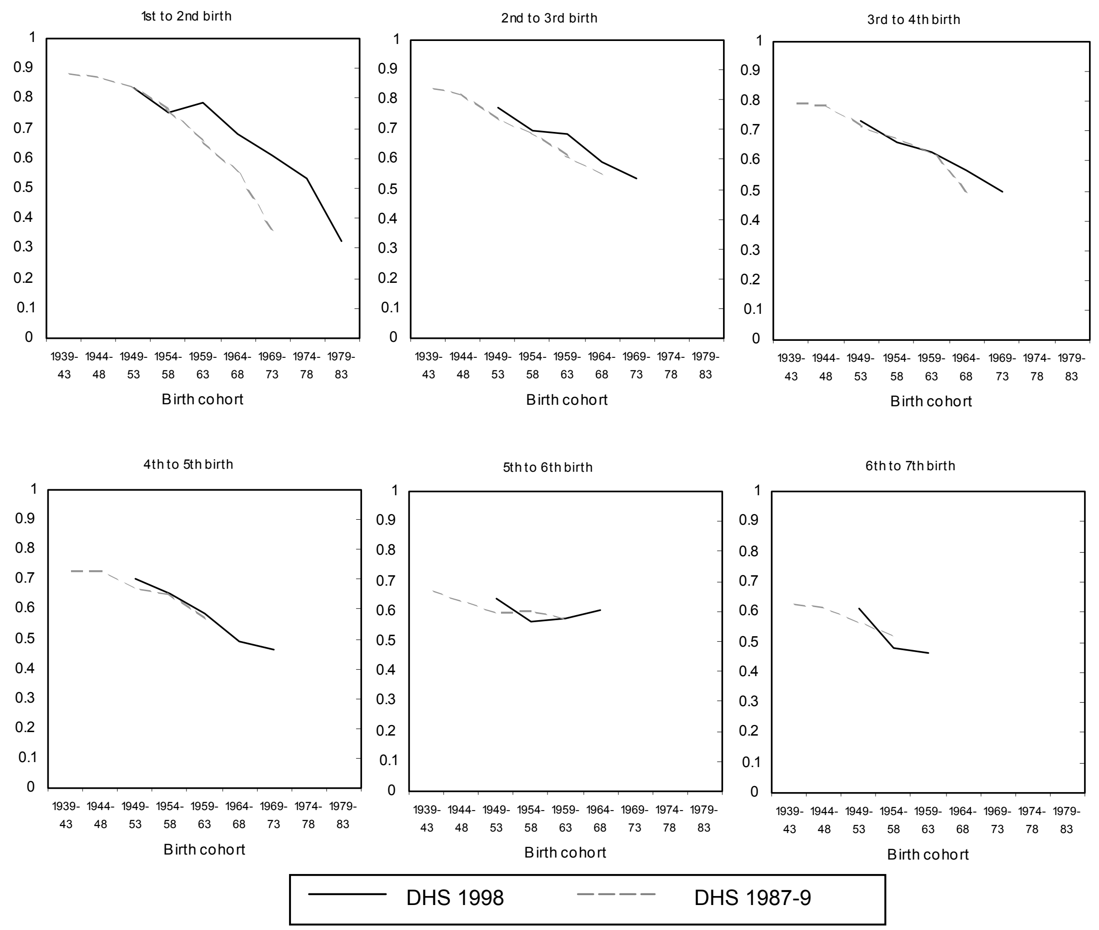


Looking at progression from first to second births in the 1998 DHS, values of both P_1 and B_{84} remain approximately constant for women in the three oldest cohorts (i.e. aged 35-49) but are lower for younger cohorts. Similar patterns can be identified for second to third order progressions. The implication is that there has been an increasing tendency (not discernible among older cohorts) for younger women to delay or stop childbearing even after the birth of a first child. There is no specific parity before which the P_n and B_{84}s are invariant, and above which they drop.

A further advantage of this approach is that it permits the use of data from the 1987-9 DHS since it is not necessary to investigate the entry of young women into motherhood in order to derive the measure. Observations similar to those made above in respect of the 1998 DHS also apply.

In addition, the (approximate) ten-year gap between the two surveys means that the values of B_{84} for women in the same birth cohort derived from two different surveys can be plotted against each other, and results in the patterns of parity progression shown in Figure 4.3.

Figure 4.3 Proportion of women progressing to another birth within seven years: 1987-9 DHS and 1998 DHS



Except for the first transition (from a first to a second birth), the correspondence between the two data series is remarkable, suggesting that the quality of the 1987-9 DHS data (at least in relation to fertility and childbearing) may not be as poor as has been suggested. In particular, Figure 4.3 demonstrates that the proportion of women progressing to a subsequent birth has been falling for all cohorts of women born after 1949. Thus, for example, while nearly four out of every five African women born before 1949 were expected to progress from a third to a fourth birth, that proportion had declined to around half among women born twenty years later.

Given the general level of agreement between the parity progression ratios calculated from the two surveys, the large discrepancy between the ratios at younger ages in the transition from a first to second birth is surprising. One explanation for the discrepancy may be that the sampling design of the 1987-9 survey (which included only married women, or unmarried women who had borne a child), encouraged fieldworkers to omit births to younger, unmarried women.

One limitation of the B_{84}s is that they mask the effect of changing times within that seven-year period during which women have a subsequent birth. This is investigated through the analysis of median birth intervals, which are presented in the next section.

4.3 The length of birth intervals among African South Africans

Survival analysis (or life table techniques) can reduce censoring bias by including truncated observations in the calculation of the exposed to risk. Summary measures of birth interval lengths that suffer less from censoring bias than simple means and medians can thus be derived from application of these techniques. Whereas life tables typically record the numbers of people surviving at a given age, those used in the evaluation of birth intervals record the numbers of women of parity i who have yet to have an $i+1$th t months since the ith birth. The survival function (a function of time, t) gives the probabilities of survival (i.e. not having a next birth within t months) and the median birth interval length is calculated (interpolating if necessary) as the time in months for which the survival function is equal to 0.5.

4.3.1 Adjusted measures of birth interval length – trimeans and quintums

Two variants of the approach outlined above are of particular value in assessing median birth intervals. The first is that suggested by Rodríguez and Hobcraft (1980). The method involves calculating separate life tables by single months since the previous birth and for each parity. The quintum, the cumulative proportion of women having a subsequent birth within 60 months, is then calculated. By standardising the life tables used to derive the quintum so that the quintum is equal to one, and calculating the durations q_1, q_2 and q_3 from this standardised life table at which 25, 50 and 75 percent of women who have a birth in the five year period have done so, the trimean, *T*, is calculated by

$$T = \frac{1}{4} (q_1 + 2 q_2 + q_3)$$

Further insight into the nature of the South African fertility transition relative to that in other countries undergoing the fertility transition can be gained from using the 1998 DHS data for African South African women to calculate quintums and trimeans comparable with those produced by Hobcraft and McDonald (1984) using data from the World Fertility Surveys. Values of the quintum for South Africa are shown in Table 4.6, together with those for a few other countries considered by Hobcraft and McDonald.

Table 4.6 Values of the quintum by parity, selected countries and African South African women

		Parity Progression						
Country	*3-year TFR*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
Kenya	8.0	0.91	0.92	0.91	0.91	0.89	0.87	0.86
Senegal	7.1	0.89	0.90	0.91	0.90	0.91	0.87	0.85
Lesotho	5.9	0.85	0.84	0.81	0.82	0.81	0.74	0.75
Venezuela	4.3	0.88	0.80	0.80	0.79	0.79	0.79	0.76
South Korea	4.0	0.91	0.89	0.81	0.73	0.67	0.63	0.54
Panama	4.0	0.87	0.83	0.79	0.77	0.77	0.74	0.73
Costa Rica	3.5	0.85	0.81	0.79	0.78	0.80	0.79	0.79
Sri Lanka	3.5	0.87	0.84	0.81	0.79	0.77	0.74	0.70
Trinidad and Tobago	3.1	0.83	0.77	0.79	0.74	0.74	0.70	0.66
SOUTH AFRICA	3.2	0.59	0.58	0.58	0.57	0.53	0.52	0.58

Source: Hobcraft and McDonald (1984), except South Africa: own calculation

By this measure, parity progression and birth intervals in South Africa are such that less than 60 percent of African women progress from one parity to the next within five years. Even when South Africa is compared only to those countries with similar levels of fertility, a clear difference exists in the values of the quintum. South African women's birth intervals are substantially longer than those elsewhere in the developing world.

The trimean for South African women, too, is noticeably longer compared to those for women in developing countries with similar levels of fertility (Table 4.7).

Taken together, the two preceding tables indicate some substantive differences between the South African fertility transition and that observed elsewhere. Comparing the data for South Africa with that for South Korea, for example, indicates that the proportion of women having a birth within 60 months is much lower at all parities, and whereas the quintums for South Korean women show a strongly decreasing trend, those for African South Africans are roughly constant. Examination of the trimean, however, suggests that the interval between births of those women having a subsequent birth within 60 months is not dissimilar. Both Senegal and Lesotho demonstrate similar patterns of fertility and childbearing to those observed among African South Africans.

Table 4.7 Values of the trimean, selected countries and African South African women

		Parity Progression						
Country	*3-year TFR*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
Kenya	8.0	25.5	25.4	25.5	25.8	26.3	26.6	26.3
Senegal	7.1	30.2	30.2	29.9	30.0	29.9	29.9	29.7
Lesotho	5.9	32.1	31.8	30.8	32.6	32.6	31.7	32.1
Venezuela	4.3	22.1	22.7	23.2	23.7	23.3	23.8	23.7
South Korea	4.3	28.3	30.6	31.5	31.7	31.2	31.7	31.2
Panama	4.0	22.7	24.1	24.5	24.3	24.4	25.0	24.8
Costa Rica	3.5	21.6	21.3	22.5	21.6	22.4	22.2	21.6
Sri Lanka	3.5	25.0	27.2	27.5	28.0	28.5	27.9	28.3
Trinidad and Tobago	3.1	22.5	22.5	22.3	22.5	22.8	22.0	22.7
SOUTH AFRICA	3.2	33.8	33.1	32.3	31.9	32.3	31.7	32.9

Source: Hobcraft and McDonald (1984), except South Africa: own calculation from 1998 DHS

In all three instances, the quintum does not vary much by parity, while the trimeans in South Africa are somewhat higher than in those two countries. As mentioned in Section 4.2.3, though, a weakness of this approach is that by its very construction, women with long birth intervals are excluded from the analysis. As the quintums for South Africa show, this systematic bias against women with long birth intervals limits our ability to draw comparisons of birth spacing in South Africa with that in other countries.

4.3.2 Projected median birth intervals

The second approach to measuring median birth intervals is to calculate paired comparison median birth intervals. This approach, derived by Aoun (1989a; 1989b), is an extension of Brass and Juárez' truncated projected parity progression technique. Projected median birth intervals are calculated in the same manner as that used for calculating adjusted B_is, but instead of using the proportion of women progressing from one parity to the next, the method uses truncated data to calculate the relative changes in median intervals between births. Thus, the approach uses the median interval between births for the untruncated and truncated cohorts (Table 4.8 and Table 4.9 respectively) to derive "indices of relative change", which are then applied to the untruncated median intervals to derive projected median birth intervals.

Table 4.8 Median birth intervals (months) by age group and parity progression, 1998 DHS and 1987-9 DHS

1998 DHS				*Parity progression*				
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
20-24	71.3	58.4	38.8					
25-29	60.6	56.4	47.0	50.1	56.3	35.2		
30-34	53.8	55.9	56.1	53.2	51.9	44.0	48.6	
35-39	43.2	47.2	51.6	54.5	52.9	57.6	41.1	42.5
40-44	44.2	49.2	49.7	47.2	64.4	66.5	41.9	36.9
45-49	35.4	38.8	40.5	42.1	50.2	49.2	48.2	42.8

1987-9 DHS				*Parity progression*				
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
20-24	57.6	50.8	43.0	37.4	31.6	45.3		
25-29	49.1	48.3	43.8	47.8	39.8	84.7		
30-34	41.4	42.3	43.2	38.8	41.6	39.7	44.7	27.6
35-39	38.2	39.6	41.1	42.3	47.7	52.9	50.5	56.0
40-44	33.3	33.9	34.8	37.9	45.1	51.9	46.2	45.5
45-49	33.3	32.9	34.5	37.1	45.4	44.9	55.2	50.9

Table 4.9 Truncated median birth intervals (months) by age group and parity progression, 1998 DHS and 1987-9 DHS

1998 DHS				*Parity progression*				
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
20-24(t)								
25-29(t)	55.7	41.8	35.7					
30-34(t)	51.4	50.9	44.3	34.4	41.0	24.5		
35-39(t)	42.5	44.5	44.4	43.8	41.5	46.6	34.7	
40-44(t)	43.9	47.7	45.9	42.4	48.0	48.7	35.5	28.4
45-49(t)	35.3	38.5	40.1	40.1	45.0	42.2	40.6	40.0

1987-9 DHS				*Parity progression*				
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
20-24(t)	49.4	44.8	30.8					
25-29(t)	43.7	41.4	38.0	47.1	41.3			
30-34(t)	39.7	39.6	37.7	33.5	44.4	30.2		
35-39(t)	37.7	38.1	37.3	38.6	41.5	47.7	50.7	35.8
40-44(t)	33.1	33.2	33.9	35.6	40.1	47.7	37.3	38.0
45-49(t)	33.2	32.8	34.2	36.3	41.6	41.3	44.6	39.5

The method produces reasonable results only where the proportion of women who have actually experienced the parity progression of interest is high. In other circumstances, where only a few women have done so, the projected median birth intervals are distorted by the magnitude of the adjustment made in respect of the indices of relative change. Hence, Table 4.10 and Table 4.11 present projected median birth intervals only for those combinations of age and parity where more than 80 percent of women have actually progressed to that parity. The data in italics reflect those combinations of age and parity where between 65 and 80 percent of women have undergone that progression. Clearly, these data are less reliable than those indicated in normal type.

Table 4.10 Projected median birth intervals (months) using the truncation approach, 1998 DHS

				Parity Progression			
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
30-34	55.4						
35-39	43.7	*49.3*	*56.7*				
40-44	44.3	49.9	*50.4*	*50.2*			
45-49	35.4	39.0	40.5	*42.7*	*50.3*		

These data show very clearly that projected birth intervals are lengthening dramatically among younger women, irrespective of parity. A similar trend is exhibited in the earlier DHS data, with median birth intervals showing signs of lengthening for more recent births (i.e. earlier parities for younger women, later parities for older women).

Table 4.11 Projected median birth intervals (months) using the truncation approach, 1987-9 DHS

				Parity Progression			
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
30-34	*42.3*	*45.0*					
35-39	38.4	40.5	*42.5*	*46.0*			
40-44	33.3	33.9	35.1	*38.8*	*49.2*		
45-49	33.3	32.9	34.5	*37.1*	*45.4*	*44.9*	*55.2*

From these data, it can be observed that the projected median birth intervals among older cohorts of women have lengthened dramatically in the 1998 DHS, while remaining virtually unchanged in the 1987-9 DHS. As with the investigation in the Projected Parity Progression Ratios, an examination of the untruncated and truncated data (presented in Table 4.8 and Table 4.9) indicates that among older women, as would be expected, the cohort effect far outweighs the truncation effect. In other words, the increase in birth intervals indicated by the application of this method is not a product of a distortion of the data introduced by the truncation procedure, but reflects significant changes in childbearing patterns between different cohorts of women.

4.3.2.1 Time location of projected median birth intervals

A further elaboration of Aoun's approach is to locate the median birth intervals in chronological time, so as to understand better the secular trend in birth intervals in South Africa over the last forty years. This is done by adding the projected median birth interval to the mean date of birth recorded for each parity by the mother's age group at the survey, and comparing this with the projected median birth interval (Figure 4.4).

Figure 4.4 Time location of births using projected median birth intervals, 1987-9 DHS and 1998 DHS

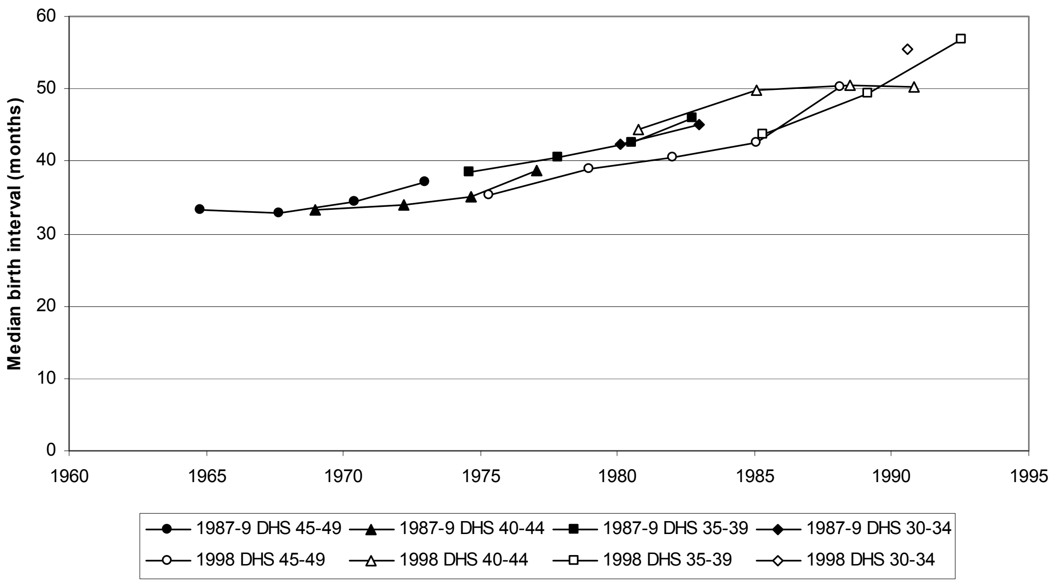


Figure 4.4 suggests that there is little significant variation in median birth interval length associated with age of mother or parity: the median birth intervals of women aged 45-49 in the 1987-9 DHS progressing to their fifth birth are very similar to those of women ten years younger who at the time were progressing to their second birth. Thus, birth intervals seem to have followed a secular trend, increasing with time, rather than being determined by mother's age or parity.

4.4 Univariate analyses of differentials in birth intervals

The method of analysing projected median birth intervals and their time location can be applied to assess differentials in median birth interval length according to background characteristics of the women being studied. Particular attention should be paid to those characteristics that are deemed to be the "proximate determinants" of birth intervals. Section 4.4.1 identifies these proximate determinants, and presents estimated projected birth intervals analysed according to them. Urban and rural differentials in median birth intervals are also assessed.

4.4.1 The proximate determinants of birth interval length

As with fertility rates, only a limited number of mechanisms directly affect the length of birth intervals. It is only through the operation of these mechanisms, or proximate determinants, that other variables (education and urbanisation, for example, as well as social and institutional effects) impact on birth intervals.

The proximate determinants of birth interval length are essentially those that determine fertility, since actions that delay or stop fertility have a direct influence on the length of birth intervals. From Davis and Blake's list of 11 proximate determinants of fertility published in the 1950s (Davis and Blake, 1956), Bongaarts (1982) distilled seven: proportion of women married; contraceptive use and effectiveness; prevalence of induced abortion; post-partum infecundability; fecundability, or frequency of intercourse; spontaneous intrauterine mortality; and permanent sterility. Of these, Bongaarts identified marriage, contraceptive use, postpartum infecundability and the prevalence of induced abortion as being the most significant in determining differences in fertility between populations.

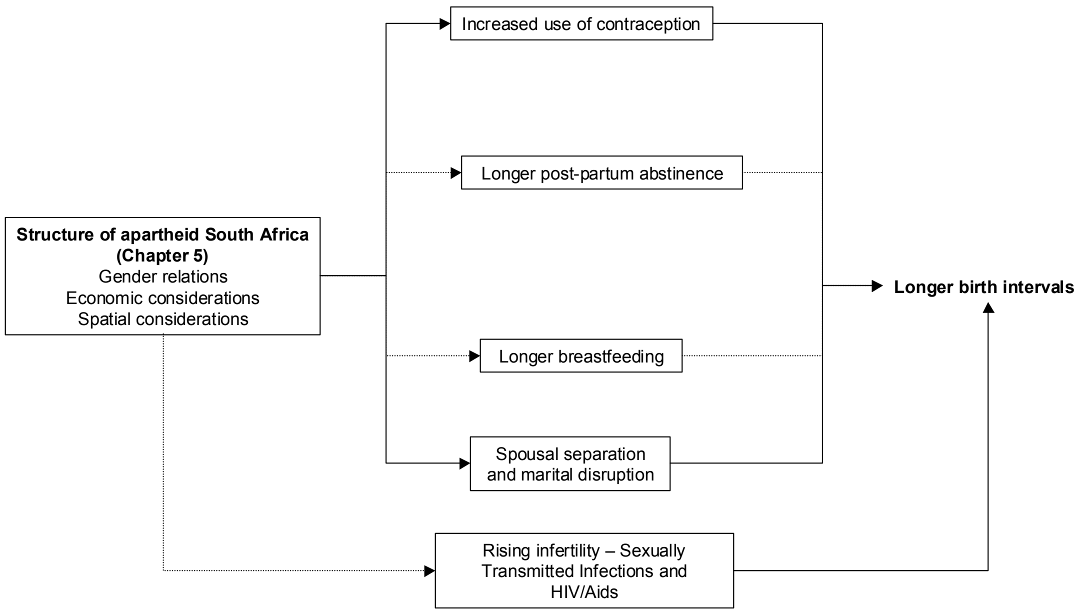
Each of the intermediate fertility variables also affect (to greater or lesser extents) birth interval length. Of these, six hold the key to understanding the dynamics of changes in birth intervals in a given society over time. Longer birth intervals will be observed if one or more of the following occur:

1. Contraceptive techniques are used to space or limit childbearing;
2. Longer periods of postpartum abstinence are observed, suppressing fertility, since even if the woman is again fecund, abstinence restricts the possibility of conception;
3. Breastfeeding is continued for longer durations, resulting in extended lactational amenorrhoea and, *ceteris paribus*, longer birth intervals (Locoh, 1994);
4. Marital relations are disrupted (or, *in extremis*, the institution of marriage is itself undermined), resulting in reduced frequency of intercourse;
5. The prevalence of induced abortion rises; or
6. The prevalence of subfecundity and secondary sterility rises as a result of the spread of sexually transmitted infections (such as syphilis or HIV) which reduce the probability of conception occurring.

However, as with the proximate determinants of fertility themselves, not all of these factors will operate necessarily in the same direction. For example, as discussed in

Section 2.3, modernisation frequently leads not only to shorter durations of breast-feeding and postpartum abstinence (indeed, this was suggested by the authors of the 1974 South Africa fertility study for the small observed differential in rural and urban fertility (Lötter and van Tonder, 1976)), but also often expands women's access to, and use of, modern methods of contraception.

Figure 4.5 Schematic diagram showing the operation of proximate determinants on the length of women's birth intervals



As Figure 4.5 indicates, it is unlikely that the second and third factors listed above would account for the increase in birth interval length observed in South Africa. If anything, in the absence of the operation of counterbalancing proximate determinants (such as use of contraception, or higher levels of abortion), one would expect birth intervals to shorten over time.

There is some evidence that induced abortion was (and remains) widespread in South Africa. Until 1975, abortion was prohibited under any circumstances. The Abortions and Sterilisations Act of 1975 made legal abortion possible, but only on five highly restricted grounds. According to the Department of National Health and Population Development (1991) and Nash (1990), fewer than 1 000 legal abortions were performed each year after 1975. The fact that abortion was, to all intents and purposes, illegal until the mid-1990s, means that no survey data exist to corroborate an increase in the prevalence of induced abortion.

Recent research has estimated that around 45 000 women present at South African hospitals each year with incomplete abortion, with induced abortion being positively confirmed in 8 percent of the 803 cases studied (Rees, Katzenellenbogen, Shabodien *et al.*, 1997). From 1976 to 1987, the annual number of operations on women of all races for removal of residues of a pregnancy varied in a narrow range from 29 000 to 36 000 (Nash, 1990). Clearly many of these operations would have been the consequence of miscarriage, but the data presented by Rees *et al.* suggest that a non-trivial proportion of these would have been to complete an induced abortion. Indeed, according to Jewkes, Wood and Maforah (1997:418), "in many cases the role of the health services was perceived to be to 'finish the job'". Using data on maternal mortality, the Department of National Health and Population Development estimated the number of illegal abortions in 1989 as approximately 42 000 (Department of National Health and Population Development, 1991). Given that not all illegal abortions result in hospitalisation, this estimate seems credible.

Access to medically assisted termination of pregnancy was expanded with the 1996 Choice on Termination of Pregnancy Act, but delays in making this service widely available mean that few women in 1998 would have had access to the service. The evidence from the 1998 DHS bears this out. Approximately half of African women interviewed were aware that the law on abortion had been changed recently. Of all African women interviewed, 10.8 percent admitted to having at least one termination, though the question did not distinguish between early miscarriage and voluntary termination. Almost twice as many White women reported an abortion, reflecting their greater access to overseas termination facilities, and the greater likelihood of their being granted a legal abortion under the earlier legislation (Nash, 1990). While there has been a noticeable upswing in the proportion of women in the 1998 South Africa DHS reporting terminations after 1996, the absolute numbers are still small: fewer than 120 (out of almost 9000) African women interviewed reported a termination after 1996. However, despite this evidence of widespread illegal termination of pregnancy, no time-series data exist to confirm or deny an increase in the incidence of such terminations in South Africa. Thus, while it is quite plausible that the incidence of illegal abortion increased over the apartheid years, the effect of this intermediate variable on women's birth intervals in South Africa can not be ascertained or investigated.

The sixth route to longer birth intervals – rising infertility – also cannot be investigated, for reasons similar to those in respect of abortion, namely inadequate data collection or surveillance systems. Nevertheless, two points should be made. First, the incidence of sexually transmitted disease (STD) has been widespread for many years in South Africa. In the late 1940s, Kark (1949) commented that "few countries can have a higher incidence" of syphilis than South Africa, while a review article in 1957 described syphilis among Africans as "endemic" (Murray, 1957). A more recent review of the literature on sexually transmitted diseases in South Africa since 1980 concluded that

> The most compelling finding is undoubtedly that STDs are endemic in South Africa. Studies show that around 17% of antenatal clinic attenders harbour at least one urogenital tract infection, and between 49% and up to 90% of women attending family planning and antenatal clinics have at least one STD… up to 15% of family planning clinic and antenatal clinic attenders are seropositive for syphilis, 16% may be infected with chlamydia, 8% may be infected with gonorrhoea, and as many as 20-50% of women have vaginal infections. (Pham-Kanter, Steinberg and Ballard, 1996:168)

More recently, the results from an epidemiological surveillance centre in rural KwaZulu-Natal suggest that, in the late 1990s, approximately a quarter of African women of reproductive age (and more than half of pregnant women) were infected with at least one STD (Wilkinson, Abdool Karim, Harrison *et al.*, 1999).

It is likely then, that the level of secondary sterility as a result of infection with sexually transmitted disease is high (and possibly increasing) among African South African women.

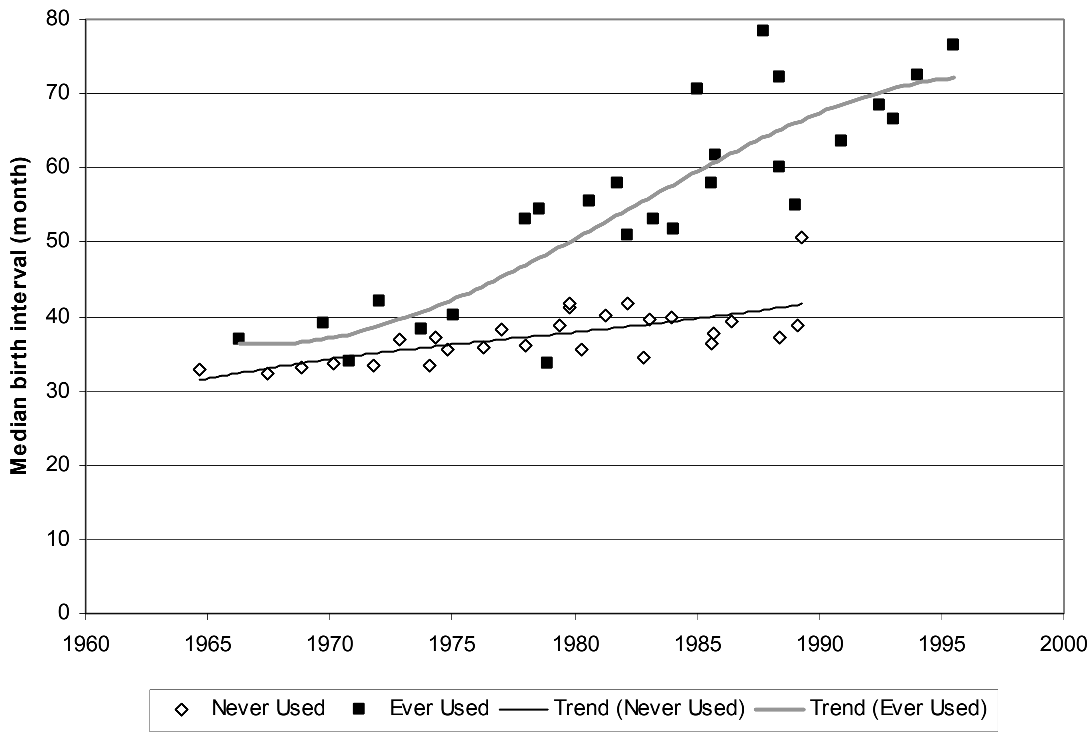
The second point is that the problem of secondary sterility will take on a hugely greater importance in future investigations of birth intervals in South Africa as a result of the spread of HIV/AIDS, since infection with the virus has been shown to inhibit women's ability to conceive (Zaba and Gregson, 1998). Some evidence to support the contention that infection with HIV is associated with longer birth intervals is presented in Chapter 7.

Thus, from the initial list of the proximate determinants of birth interval length, two are left open to initial investigation: the potentially lengthening effects of the use of contraception and the impact of spousal separation and marital disruption on birth intervals.

4.4.1.1 Use of contraception

The data collected in the South African Demographic and Health Surveys are not ideal for assessing changing patterns of contraceptive use (and differentials within these patterns) over time, as contraceptive use histories were not collected in either the 1987-9 or the 1998 survey. As a result, operationalisation of a contraceptive use variable is restricted to a simple binary: had a woman ever used any form of modern contraception prior to the birth of the index child. Such a variable does not distinguish between long-term regular, efficient use on the one hand, and short-term 'experimentation' on the other. However, even with these limitations, a clear difference exists in projected median birth intervals between women who had never used modern contraception before the birth of the index child, and women who had (Figure 4.6), although there is some selectivity at work here, by virtue of the expanded access to modern contraception methods as a result of the government's family planning programmes. Thus, the proportion of women in each group will not have remained constant over time.

Figure 4.6 Projected median birth intervals (months) of African women, by ever use of contraception prior to birth, 1998 DHS and 1987-9 DHS



Birth intervals among women who had used modern contraception before the birth of the index child have lengthened rapidly over time, while those among women who had not used modern contraception have drifted only upward gradually from around 35 to approximately 40 months. Thus, the overall increase in birth intervals in South Africa since 1960 is strongly associated with the uptake and increased use of modern contraception by an increasing proportion of the African population over time.

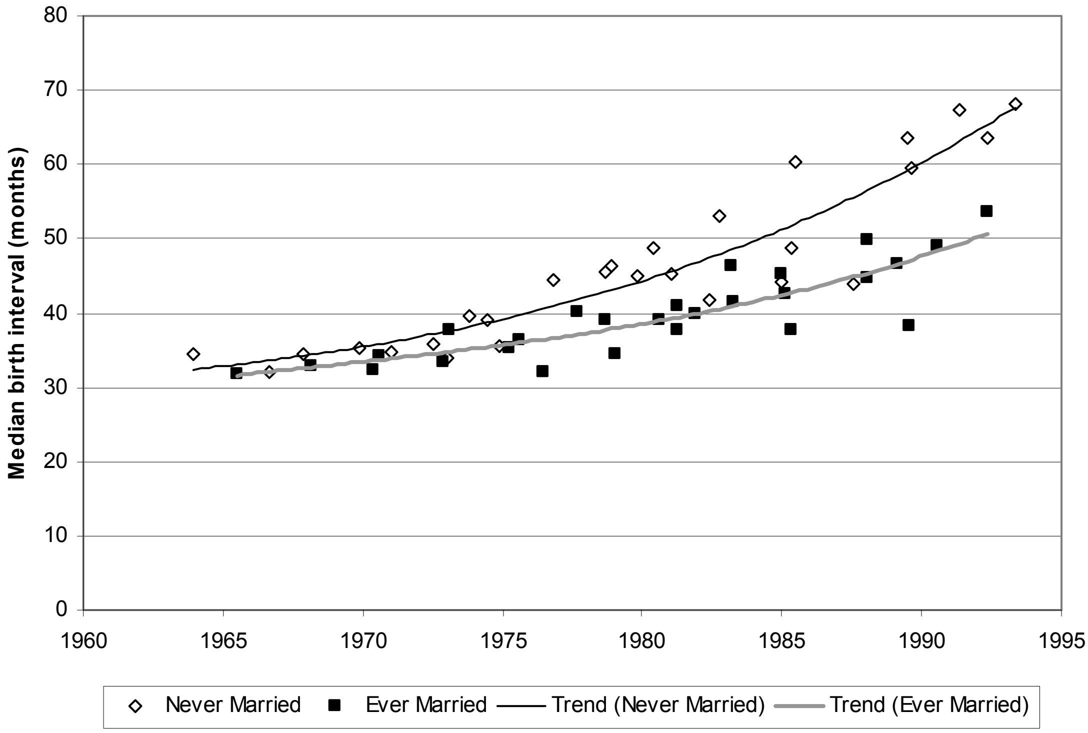
4.4.1.2 Marital disruption

The remaining proximate determinant, spousal separation and marital disruption, is of great importance in societies characterised by high levels of labour migration, as is the case in many Southern African countries. In these circumstances, men are frequently absent from their wives, thereby reducing the time available for conception to occur. However, the effect of spousal separation on fertility (and hence birth intervals) depends not only on the length of separation, but also on the ages of the partners while they are separated and "degree to which the separation coincides with fecundable periods rather than pregnancy or postpartum anovulation" (Millman and Potter, 1984:122). Based on an analysis of the Lesotho World Fertility Survey data, Timæus and Graham (1989) found that male labour migration reduced the level of marital fertility by around 9 percent. In another study of the same country, Timæus (1984a) observed that "birth intervals tend to be rather long in Lesotho". Similar factors are, and were, most probably at work in South Africa, too, since both countries are subject to similar forms and levels of labour migration.

However, in South Africa, the association of marital status with longer birth intervals is less obvious than the effect of contraceptive use. As with the contraception data in the South African DHS surveys, the absence of a full marital history means that a simple binary variable has to be deployed to assess the effect of marital status on women's birth intervals, namely whether or not the woman had ever been married at the time of the birth of the index child. Although there is no strong social sanction against pre-marital pregnancy in South Africa (Preston-Whyte, 1978), one would expect that birth intervals for never-married women would be somewhat longer than those among women who had ever been married (even if they were not necessarily married at the time of that particular birth).

As expected, Figure 4.7 shows that birth intervals for never-married women are indeed longer than those for women who had been married at the time of birth. However, the trends in median birth intervals are broadly parallel, suggesting that the underlying forces on women's birth intervals operated more or less uniformly, regardless of the women's marital status at birth. One possible explanation is that marital relations in South Africa have become so disrupted that the situations in which many ever-married women bear children closely resembles that of women who have never been married. This may occur as a result of women bearing children from successively different fathers for example. No matter the explanation, Figure 4.7 suggests that having married is not a strong predictor of the trend in women's birth intervals.

Figure 4.7 Projected median birth intervals of African women, by ever married status prior to birth, 1998 DHS and 1987-9 DHS



4.4.2 Preceding intervals as a determinant of birth interval length

Several studies (see, for example, Gilks (1986) and Rodríguez, Hobcraft, McDonald *et al.* (1984)) have suggested that the single most significant variable in determining the duration between successive births is the duration of the woman's preceding birth interval.

This relationship, while interesting and intuitively obvious, should be treated with some circumspection as it is hard to conceptualise how the preceding birth interval acts on the proximate determinants in a directly causal fashion. More importantly, however, this relationship suggests that, in many respects, women's birth intervals are both path-dependent, and unaffected by structural changes in society. By intimating that women's maternity history determines their subsequent childbearing, this literature ignores the effect of secular changes in social perceptions and ideals. An analogy can be found in a woman's reported ideal number of births, which has been shown to be correlated strongly with her current parity – and is hence self-fulfilling. Indeed, Hobcraft and Murphy (1986:11) question whether the association between the length of the preceding interval and the current birth interval duration is "due to true state dependency, unobserved heterogeneity, or omitted explanatory variables, themselves correlated between intervals".

This is not to deny that women can exercise control over their childbearing: clearly, women who desire many children will tend to have shorter birth intervals. Similarly, women who do not use modern contraceptive methods when others do, will have shorter intervals. The essential point, however, is this: that over an individual woman's life-course, her own assessment of the number of children she would like to bear, and the desired interval between them, will be subject to change arising from changing social and cultural prescriptions and ideals, as well as her own experience. Taken together, this suggests that the immediately preceding birth interval cannot and should not be viewed as causally related to the subsequent interval. Rather, women's preceding birth intervals should be viewed as an indicator of their fecundity, and of unmeasured (and unmeasurable) social, economic and cultural traits.

4.4.3 Rural/urban differentials in birth interval length

The final univariate analysis of trends and differentials in birth intervals is that of current residence. This analysis is included not because residence is deemed to be a proximate determinant of birth interval length (it is not), but because other data exist relating to women's birth intervals in metropolitan areas in the early 1970s against which these more recent data can be compared. Since the DHS data do not provide a full residence history for women surveyed, current residential status is used instead. Median birth intervals among urban women are much longer than those among rural women (Table 4.12, Table 4.13 and Figure 4.8).

Table 4.12 Projected median birth intervals (months) using the truncation approach, urban and rural areas, 1998 DHS

				Parity			
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
Urban							
30-34	66.9						
35-39	50.6	*64.3*					
40-44	49.9	65.8	*67.4*	*70.2*			
45-49	37.8	44.0	48.0	*53.3*	*66.0*		
Rural							
30-34	43.8						
35-39	37.8	*40.8*	*45.7*				
40-44	38.8	39.4	*37.3*	*40.6*			
45-49	33.2	35.7	36.5	*37.1*	*41.4*		

Note: Data in italics represent those projected median birth intervals calculated for women where between 65 and 80 percent of women of that combination of age and parity have progressed to a subsequent birth. Data in normal type represent birth intervals calculated for combinations of age and parity where more than 80 percent of such women have progressed to a subsequent birth.

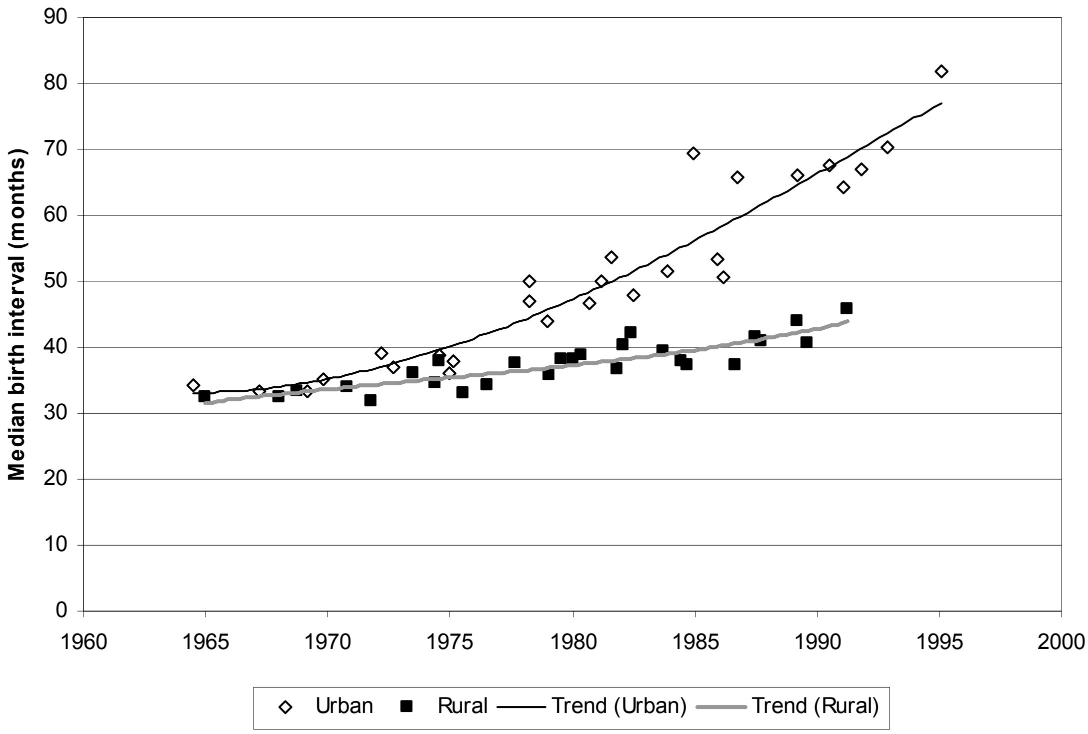
Table 4.13 Projected median birth intervals (months) using the truncation approach, urban and rural areas, 1987-9 DHS

				Parity			
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
Urban							
30-34	*46.8*	*51.6*					
35-39	38.9	46.9	*53.5*	*69.5*			
40-44	33.3	37.0	36.1	*50.0*	*51.5*		
45-49	34.3	33.5	35.0	*39.2*	*48.8*	*46.3*	
Rural							
30-34	*38.1*	*42.1*					
35-39	37.7	37.7	*38.2*	*40.2*			
40-44	33.3	31.9	34.5	*34.3*	*45.5*		
45-49	32.3	32.4	34.0	*36.0*	*42.4*	*43.6*	*42.3*

Note: Data in italics represent those projected median birth intervals calculated for women where between 65 and 80 percent of women of that combination of age and parity have progressed to a subsequent birth. Data in normal type represent birth intervals calculated for combinations of age and parity where more than 80 percent of such women have progressed to a subsequent birth.

Interestingly, however, this differential was not apparent until after the implementation of the first National Family Planning Programme in 1974, suggesting that the pattern of increase in birth intervals is strongly associated with the availability of modern contraceptive methods in both urban and rural areas. As shown earlier, birth intervals among women who had not used modern contraceptive methods before the birth under investigation have hardly altered in the last thirty years, while birth intervals among women who had, have increased dramatically. In many respects, this finding is intuitive, since lengthening of birth intervals is made much easier with the use of modern contraception.

Figure 4.8 Projected median birth intervals (months) of African women, by place of residence, 1998 DHS and 1987-9 DHS



4.5 Unadjusted mean and median birth intervals

As a summary measure, mean birth intervals suffer from both truncation and censoring biases. They can only be calculated using those intervals that are closed. If open birth intervals are included, the invalid assumption is made that all open intervals are closed on the survey date. By restricting the calculation only to closed intervals, however, the measure is biased by the fact that "fast breeders" (i.e. women with shorter birth intervals) are likely to be disproportionately represented in the calculation, and hence the mean closed birth interval will tend to indicate somewhat shorter mean birth intervals than is actually the case.

The use of median closed birth intervals suffers from the same drawbacks. However, the use of the median is preferable to the use of the mean, since the distribution of closed birth intervals will tend to be strongly right tailed and hence the median provides a more robust summary measure of closed birth intervals, undistorted by the underlying distribution of birth intervals.

Due to the limitations of this summary measure, mean birth intervals are presented only for comparative purposes with other published data. The analysis of birth intervals in urban areas, and their time location presented in the preceding section gives a strong indication of the changes in birth intervals by cohort. Further evidence of the magnitude of this change can be gleaned from a series of reports issued by the Human Sciences Research Council (Mostert, 1972; Mostert and du Plessis, 1972; Mostert and Engelbrecht, 1972; Mostert and van Eeden, 1972). These surveys investigated fertility, contraceptive use and family formation among married (legally or otherwise) African women aged 15-44 living in four major urban areas in 1969-70. Unfortunately, a breakdown of these data by age of woman is not available, necessitating the presentation of data unstandardised by age.

Table 4.14 Mean (closed) birth intervals in months for married African women in major metropolitan areas, by parity

			Parity progression							
City & Year	*N*	*Mean age*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
Cape Town 1969-70	573	31.3	30.9	30.3	27.8	31.0	29.7	30.3	29.1	27.0
Durban 1969-70	1071	32.1	33.0	31.5	29.3	29.6	28.9	26.6	28.1	28.8
Pretoria 1969-70	978	32.6	37.6	33.1	32.2	32.2	30.5	30.3	30.9	28.5
Soweto 1969-70	1016	33.4	38.2	33.7	34.0	33.2	31.0	28.2	25.6	28.2
Weighted 1972	3638	32.5	35.4	32.4	31.2	31.5	30.0	28.6	28.3	28.3
DHS 1987-9	316	29.5	38.6	36.5	37.4	36.1	38.6	30.4	--	--
DHS 1998	633	33.5	52.7	51.5	49.5	44.1	49.1	41.7	23.3	27.5
Annual percent change (1972-1987/9)			0.5	0.8	1.2	0.9	1.6	0.4		
Annual percent change (1987/9-1998)			3.2	3.5	2.8	2.0	2.4	3.2		
Annual percent change (1972-1998)			1.5	1.8	1.8	1.3	1.9	1.5	-0.8	-0.1

Source: DHS 1998, DHS 1987-9, Mostert (1972), Mostert and du Plessis (1972), Mostert and Engelbrecht (1972), Mostert and van Eeden (1972)
In order to compare these results with those from the 1987-9 and 1998 South Africa DHS, the data have been restricted to married or cohabiting African women living in cities aged between 15 and 44. While the equivalent sample sizes in the 1987-9 and 1998 Demographic and Health Surveys are much smaller than those of the 1969-70 studies, they are still sufficient to be of use.

The use of closed birth intervals biases the mean birth intervals downwards, as can be seen from a comparison between the data presented in Table 4.14 and the previous two tables. Moreover, while the results are not indicative of national trends in childbearing and birth intervals, they are nevertheless instructive. The results presented in the last three rows of Table 4.14 indicate that a major change has occurred in urban African fertility in South Africa over the last 30 years. While mean intervals at higher parities have changed little, at lower parities mean closed birth intervals have increased by between 40 and 60 percent. Furthermore, the data show a substantial increase in the annual rate at which closed birth intervals have lengthened over the time period covered by the three surveys.

These findings are both important and significant. Younger women in South Africa are less likely to progress to higher-order births than older women. At the same time, those that do progress are taking much longer to do so. The mean closed birth intervals at lower parities of married women of reproductive age have increased by more than a year over the last 30 years in South Africa's cities – from under 3 to over 4 years.

4.6 Discussion

This chapter set out to investigate the pattern of childbearing and birth spacing among African South Africans using two DHS surveys. A number of highly important findings emerge from the investigations undertaken, and it is worth dwelling on these at some length.

First, African women's progression from one parity to the next shows that the South African fertility decline has not been characterised by parity-specific fertility limitation in order to conform to social norms relating to an 'optimal' number of children that women should bear. This confirms the findings presented in Chapter 3 that the South African fertility decline exhibits some similarities with that in other African countries.

Second, the values of B_{84} from two sets of DHS data reveal that the proportions of women progressing to a subsequent birth have been declining for all cohorts of women born after 1949. Since high levels of teenage pregnancy have prevailed in South Africa since the 1950s at least (see, for example, Eloff (1953a) and Nash (1990)), this suggests that parity progression ratios in South Africa probably started falling no later than the late 1960s. The cohort of women born between 1949 and 1953 would have been aged between 21 and 25 at the official launch of the government's family planning programme in 1974 (although, as shown in the next chapter, Africans' access to contraception had been expanded gradually from the mid-1960s. That chapter, too, indicates that large numbers of African women were using modern contraceptive methods by the mid-1970s.) Thus, the decline in parity progression ratios documented above is at least temporally associated with this greater access. Furthermore, it is apparent that the increase in African women's birth intervals commenced at approximately the same time, suggesting that the increase in birth intervals, too, is associated with the implementation of the government's family planning programme. Thus there is evidence of both cohort and period effects in the timing of the South African fertility decline.

The evidence presented in the previous chapter suggests that African fertility had begun to fall (albeit very slowly) before 1970. Given that estimated onset of the fertility decline, it is not surprising that the general trend in parity progression has been downwards for all parities, across all the cohorts covered by the two DHS surveys. The B_{84} values decline roughly in parallel with the values of P_i. Thus, there is little evidence that the latter have been distorted by changes in the tempo of fertility.

The calculation of these Censored Parity Progression Ratios also provides the first intimation of the possibly unique length of birth intervals in South Africa. Previous research into birth intervals in the developing world found that the majority of women who will ever progress to a subsequent birth do so within five years of their previous one. In South Africa, a window of seven years was required for the values of the Censored Parity Progression Ratios to come close to the Projected Parity Progression Ratios.

The greatest limitation of the approaches used to determine parity progression ratios and birth intervals, however, is that they do not readily permit statistical testing of hypotheses relating to differentials in, and determinants of, birth interval length. Survival functions can be graphed and examined visually for differentials in birth interval length, but these do not tell us whether any differences are statistically significant or not. Furthermore a formula does not exist whereby confidence intervals can be placed around the values of B_{60} and B_{84} calculated according to Brass and Juárez' approach[1]. Chapter 7 sets out and applies an approach to analysing survival data using statistical techniques.

Chapter 3 presented results that showed that the age pattern of fertility in South Africa is fundamentally similar to that observed in other African countries, even though the fertility decline had started much earlier, levels of fertility are lower and contraceptive use in the country is higher than elsewhere in sub-Saharan Africa. Further insights into the similarity (or otherwise) of the South African fertility transition relative to other

[1] Confidence intervals for these measures can be derived using Monte Carlo simulation approaches, provided the underlying distributions are well specified. The calculation of such confidence intervals are, however, beyond the scope of this thesis.

countries in sub-Saharan Africa can be gained from a comparison of values of B_{60} for South Africa with those for other African countries presented by Cohen (1993). He calculated values of B_{60} for eight countries, three of which (Botswana, Kenya and Zimbabwe) had already shown evidence of a decline in fertility. The data for these three countries, as well as values of B_{60} calculated from the 1987-9 and 1998 South African demographic surveys, are presented in Table 4.15.

Table 4.15 Values of B_{60} by age group and grouped parity, selected African countries

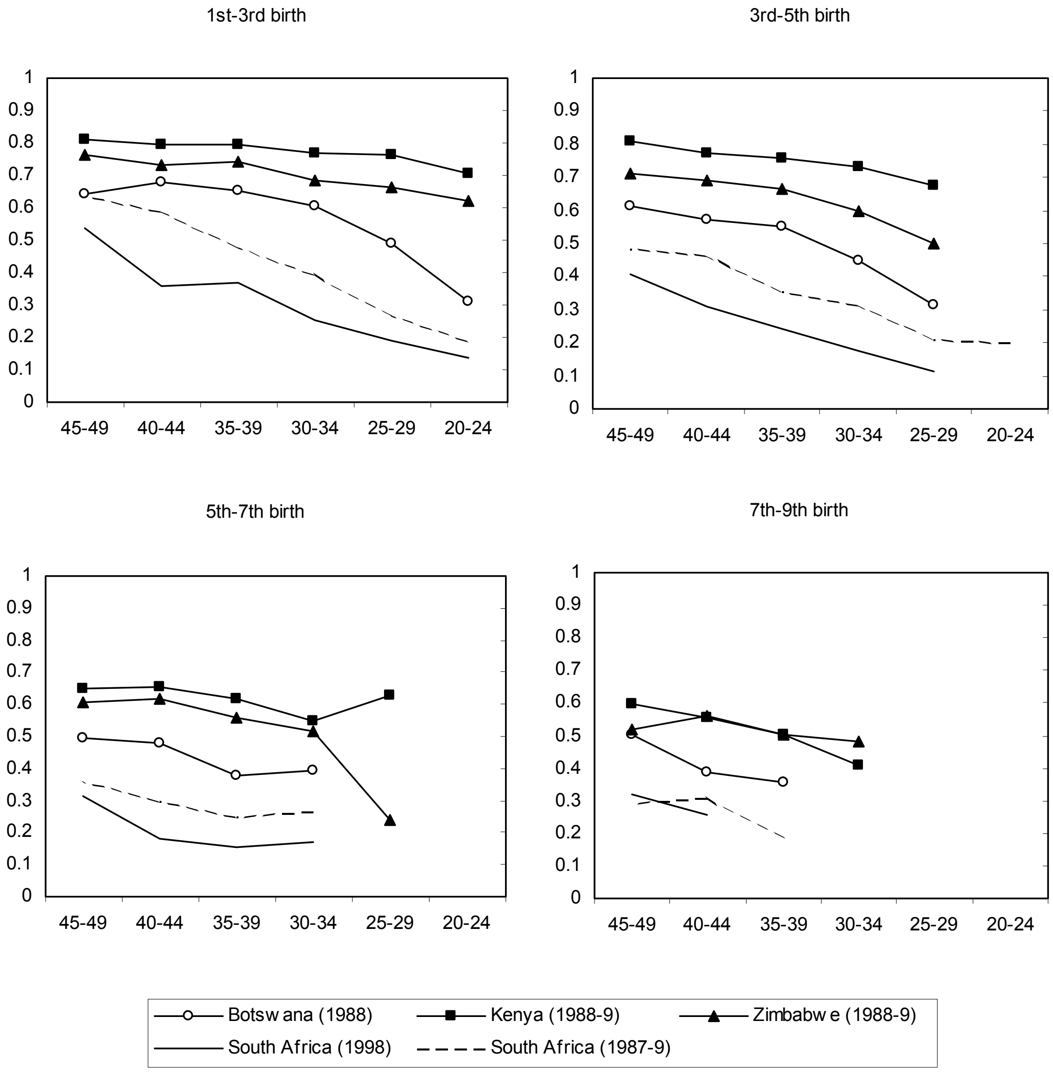
	Parity Progression			
Country (Year; TFR)	*1-3*	*3-5*	*5-7*	*7-9*
Botswana (1988; 5.0)				
20-24	0.308			
25-29	0.487	0.312		
30-34	0.604	0.446	0.395	
35-39	0.652	0.549	0.379	0.356
40-44	0.678	0.571	0.480	0.388
45-49	0.644	0.615	0.495	0.505
Kenya (1988-9; 6.6)				
20-24	0.704			
25-29	0.761	0.675	0.626	
30-34	0.771	0.734	0.547	0.408
35-39	0.794	0.759	0.616	0.504
40-44	0.797	0.772	0.652	0.553
45-49	0.813	0.811	0.650	0.596
Zimbabwe (1988-9; 5.5)				
20-24	0.622			
25-29	0.664	0.500	0.237	
30-34	0.682	0.598	0.518	0.481
35-39	0.741	0.666	0.559	0.504
40-44	0.733	0.689	0.616	0.560
45-49	0.765	0.709	0.605	0.518
South Africa (1987-9; 4.6)				
20-24	0.189	0.198		
25-29	0.270	0.211		
30-34	0.392	0.315	0.267	
35-39	0.479	0.354	0.249	0.188
40-44	0.587	0.466	0.299	0.309
45-49	0.638	0.486	0.363	0.294
South Africa (1998; 3.5)				
20-24	0.139			
25-29	0.190	0.113		
30-34	0.254	0.175	0.169	
35-39	0.370	0.240	0.153	
40-44	0.360	0.311	0.179	0.259
45-49	0.535	0.405	0.316	0.322

Source: Data for Botswana, Zimbabwe and Kenya come from Cohen (1993). Data for South Africa calculated from 1987-9 and 1998 South Africa DHS.

Note: Figures in parentheses indicate the year to which the data refer, and the total fertility rate at that date.

By this measure, the fertility decline in South Africa again shows both similarities to (and differences from) that in other African countries. Presented graphically (Figure 4.9), these data encourage (and demand) further reflection on the nature of the South African fertility decline relative to that elsewhere in Africa.

Figure 4.9 Values of B_{60}, by cohort and grouped parity, selected African



countries

In all cohorts, and at all parities, the proportion of women progressing to higher order parities is much lower in South Africa (at both surveys) than in the three other countries shown. At the higher parities, a remarkable similarity in trend (if not level) between the data from the five surveys is apparent.

Strong similarities in the pattern of childbearing in Zimbabwe and Kenya are evident, while the pattern of B_{60}s in Botswana lies between those for those two countries and South Africa. The two sets of data from South African surveys show how the proportion of women progressing to a subsequent birth within five years of their last has fallen over a fairly short period of time. The fall in the values of B_{60} in South Africa, and the similarity to other African countries in their pattern across cohorts raises the possibility that the pattern of fertility decline in South Africa may be a harbinger of the pattern of decline in other African countries.

The further investigation of these similarities and differences lies outside the scope of this thesis. However, the data presented above might suggest that there is a general pattern in parity progression that stretches across African countries. In particular, it would be of interest to investigate whether the proportion of women progressing to higher parities in more recent years in those three other African countries have moved closer to the levels shown in South Africa.

Thus, again, the South African fertility decline exhibits some similarities to that in other sub-Saharan African countries. The decline has resulted more from a general fall in the proportion of women progressing to higher parities than from parity-specific fertility limitation. In many respects, then, the South African fertility decline is occurring as Caldwell, Orubuloye and Caldwell (1992) hypothesised. Fertility decline is occurring at all ages and parities simultaneously.

The major finding of this chapter, however, is indubitably the observation of exceptionally long birth intervals in South Africa. The median birth intervals presented in Section 4.3 indicate a level of spacing between births that is unique to South Africa, with recent intervals for younger women frequently greater than seven years.

Furthermore, birth intervals in South Africa have lengthened enormously over the last thirty years, certainly by African standards and also in comparison with those observed elsewhere in the developing world. Data were presented in Chapter 2 showing the median birth intervals for a sub-population of women of childbearing age in 13 sub-Saharan African countries. The longest birth intervals identified were those in Zimbabwe, of 39 months. The same calculation for the equivalent group of African South Africans, however, yields a median interval of 59 months. By this measure, then, the pattern of childbearing in South Africa is qualitatively different from that elsewhere in sub-Saharan Africa. Similarly, the quintums and trimeans calculated in this chapter indicate that the proportion of African South Africans progressing to a subsequent parity within five years of the last birth are much lower than those observed elsewhere in the developing world, even in countries with similar levels of fertility. Further, even for women who do have another child within five years, the trimean for African South Africans is appreciably higher than that generally observed. In this regard at least, the pattern of childbearing in South Africa is – and has been historically – qualitatively different from that seen elsewhere in the developing world. International comparisons are of little help in understanding or explaining why this pattern has emerged.

From this perspective, South Africa can be said to be following a new variant of the fertility transition, characterised by both lengthening birth intervals and low parity progression ratios. Whether other African countries are following this pattern might be a profitable direction for future research. However, in the absence of being able to determine whether or not this is indeed the case, it is necessary to consider the forces that have precipitated this pattern of fertility and childbearing in South Africa. An explanation for this pattern might well lie in the history and evolution of political, social and economic institutions under apartheid and its segregationist antecedents. The validity of this as a potential explanation is investigated in the next two chapters.

5 HOLDING BACK THE TIDE, WAITING FOR THE FLOOD: POLITICAL DISCOURSE ON POPULATION AND AFRICAN FERTILITY IN SOUTH AFRICA

Chapter 2 set out an argument that, although recognising the existence of an intellectual orthodoxy that prevailed in demographic research from the end of the Second World War, this orthodoxy was far from hegemonic. This chapter investigates the rhetoric and discourse of population policies in South Africa from the turn of the twentieth century through to the dismantling of apartheid in the late 1980s and early 1990s.

The primary purpose of this investigation is to provide a historical context for the analysis of the effect of apartheid institutions on the African South African fertility decline presented in the next chapter. The material presented here shows how apartheid intellectuals and ideologues constructed the threat of rapid African population growth, state responses to this apparent threat, and the consequent evolution of population policies in South Africa. The rhetoric and the population policies adopted, furthermore, are situated in the context of the changing international debates and theories on population growth, family planning programmes and development (and the relationships between them) from the 1950s onwards.

5.1 The racialisation of the South African polity: 1900-1948

Matters relating to race, and the establishment and maintenance of White hegemony became increasingly central to South African politics and policies from the turn of the twentieth century. Legassick (1995:44) argues that the "crucial formative period for the policy of segregation" was between 1901 (the penultimate year of the Boer War) and the start of the First World War in 1914. While components of a segregationist polity had been established earlier in the nineteenth century, these did not take on the mantle of a "totality created of ideological rationalisation, economic functions and legislative-administrative policy" (Legassick, 1995:44-5). Nevertheless, as Legassick observes, colonial administrators and commentators in the nineteenth century were entirely aware of the differential rates of population growth in the country, and their likely consequences.

Contemporary anthropologists wrote about Africans in terms that were likely to feed the paranoia of the colonial elite about the numbers of Africans vis-à-vis the number of Whites. According to one, native Africans ("Bantu") were possessed of robust constitutions, looked younger and were likely to live longer than Whites, and were particularly worthy of detailed study because they "outnumber by more than threefold all the other inhabitants of [South Africa] put together, and are still increasing at a marvellous rate" (Theal, 1910:102). An entire subsequent chapter of this book was simply entitled "Rapid Increase of the Bantu in Number", and devoted itself to an exposition of the supposed causes of rapid population growth among Africans. Commentators and anthropologists such as Theal placed emphasis on the fact that, unlike other colonial situations, native South Africans had suffered no large demographic setback as a result of disease introduced by colonial settlers. Hence, unlike elsewhere, there was no obvious brake being applied to the growth of the indigenous population.

The histories and anthropological accounts of the time thus suggest that the numerical dominance of the indigenous inhabitants over the colonial settlers was an important concern of colonial administrators. It is in this context, Beinart and Dubow (1995:2) argue, that segregationist policies emerged from the realisation that although Europeans had "conquered the indigenous population, [they] could only partially displace it". It was in this desire for displacement that the racialisation of South African demography took root.

Initially, the justification for the displacement of the indigenous population (and, hence, the maintenance of urban areas for Whites, while still retaining a population of African workers) found its expression in the discourses of public health. One such example was the forced removal of Africans to Ndabeni township on the outskirts of Cape Town in March 1901, motivated primarily by the threat posed by Africans to public health after an outbreak of bubonic plague in the Cape Town docks (Swanson, 1977). While these concerns (what Swanson terms the "sanitation syndrome") offered a convenient pretext for enforced urban segregation, Maylam (1995) and other historians have argued that this discourse also (and more importantly) provided a vehicle by which White capitalist interests in the cities could be safeguarded and preserved. Through a series of legislative acts in the years after Union in 1910 (including the 1913 Native Land Act which set aside 13 percent of South Africa's land area for Africans, and the first legislation of race-based job reservation – the "civilised labour policy"), these interests were further entrenched and their continuity assured. With this, the concerns of White South Africans turned increasingly to the 'political arithmetic' of the Union, and from the mid-1920s, the racialised discourse of public health was superseded by White fears that they were being overwhelmed by the pace of growth of the African population, fears in keeping with the eugenicist ideas prevalent in Europe and America at the time.

Prior to, and in the aftermath of, the formation of the Pact Government in 1924, JBM Hertzog (elected Prime Minister in 1924) used the rhetoric of swamping to call for the extension and preservation of White privilege, and the continued denial of African rights. In three speeches between May 1924 and May 1926, Hertzog gradually developed his theme that segregation was required because of the numerical superiority of Africans. Initially, his overriding concern was with the government's "civilised labour policy", although he did argue that if a solution to the "native question" was delayed much longer, it would be the "death of both European and native" (Hertzog, 1977 (1924):307*)[1]. By November 1925, the use of the swamping metaphor was in currency: extending the (qualified) franchise that Africans enjoyed in the Cape to other provinces "necessarily must lead to the swamping of the White population, and European civilisation in the Union" (Hertzog, 1977 (1925):21*).

These ideas were developed in the following months. At a speech in Malmesbury in early 1926, after presenting summary statistics of the racial composition of the Union (Africans then outnumbered Whites by a margin of 3 to 1), he proposed that "numbers take on practical value only when they are raised in connection with matters of importance. Only then do they carry any meaning for us. Therefore, the relationship of the population numbers of the native relative to the European only are imbued with their full meaning when we can grasp the difference between the two races…." (Hertzog, 1977 (1926):71*).

Thus, according to Hertzog, the numerical balance between Whites and Africans would be unimportant were it not for the supposed cultural, religious and socio-economic differences between the two race groups. Hertzog's views set the parameters for the debate on population issues for the next twenty years. Dubow argues that, while the significance of Hertzog's use of rhetoric on swamping has been overlooked and ignored by South African historians of the liberal school, the rhetoric of swamping is more comprehensible when assessed in the context of the eugenicist movement "with its paranoia about civilisation's retrogressive tendencies and its vulnerability in the face

[1] Throughout this chapter, an asterisk in the citation indicates that I have translated the quoted text from the original Afrikaans.

of the ‘virile’ mass of ‘barbarians’ who were ‘flooding’ into the cities” (Dubow, 1995:156).

In a series of House of Assembly debates in the early 1930s (cited in Kaufman, 1996:15-7), African population growth was described variously as “disturbing” and as a possible “menace”, while the African urban areas themselves were described as “congested with a large, and superfluous, native population”. Although the first clinics were set up by private organisations to minister to the family planning needs of non-Whites in the mid-1930s in response to these concerns, Kaufman (1996) points out that far greater emphasis was placed at the time on maintaining or ‘improving’ the ‘quality’ of the White population.

While the rhetoric of swamping continued unabated through the twenties and thirties, it was only in the mid-1930s that Afrikaner nationalists first began to consider seriously the possibility of legalised and systematic segregation of the Black and White South African populations (Dubow, 1992). Their unanticipated victory in the 1948 election, during which they “hammered relentlessly at the theme of the black *oorstroming* (inundation) of the cities” (O’Meara, 1996:34), gave the Nationalists an opportunity to put some of these ideas into practice.

5.2 Contradiction, continuity and change: 1948-1968

Although the apartheid era commenced with the electoral victory of the National Party over the United Party in 1948, many of the foundations of the apartheid state had been laid down gradually over the preceding decades. Thus, while post-1948 South Africa saw the codification and consolidation of many segregationist policy measures, in many respects the 1948 election did not mark a watershed in the nature of racialised discourses, but rather a formalisation and extension of debates and policies that had been in play for some time.

Through a detailed analysis of the evolution of government policies on influx control, Deborah Posel (1991; 1995) has shown that, contrary to the perceptions of many, apartheid was not a singular, hegemonic or monolithic ideology. In the decade after 1948, she claims, apartheid was an amalgam of policies forged out of conflict and compromise within and between White ruling classes and other interest groups with consequently serious internal contradictions existing between and within different policy arenas.

The emergence of similar contradictions in the framing of the debate on population issues in South Africa between 1948 and the late 1960s can be identified. On the one hand, driven by the fear of White South Africans being "swamped", the government desired a rapid reduction in African fertility. On the other, it pursued policies that ensured that Africans were systematically denied access to education, health care and urban residence. Yet – according to the modernisation thesis to which the government subscribed – all these factors are conducive to fertility change. These tensions were to play themselves out right up to the 1990s. Indeed, it is one of this thesis' central arguments that these tensions (and their institutional consequences) are responsible in a large measure for the pattern of fertility decline observed in South Africa since the 1950s.

What was significant post-1948, however, was the explicit articulation of White fears about the population dynamics that were afoot in the country, and the attempted resolution of these fears within a broader set of government policies. Within two years of the Nationalists' coming to power, Jan Sadie, one of the most eminent and prolific South African demographers, wrote in the first volume of the *Journal of Racial Affairs*[2]:

> Numbers are the essence of democracy, where one person means, or may mean, with certain reservations of course, one vote. The population, its growth or decline, births and deaths, the racial composition, are the basic data of politics. The need for the study of population statistics is obvious.
>
> In South Africa the outstanding problem, dominating all others, is the relative numbers of the different races constituting the Union's population, and their differential rates of growth. For in the long run numbers must count. (Sadie, 1950:3)

and later in the same article:

> For those who profess interest in the preservation of European civilisation in South Africa and who are willing to face the facts, there is only one inference to be drawn from the above conclusions. If the Europeans do not want themselves to be swamped – and it may be in the interest of the Native too that the European are not so swamped, at least during the next fifty

[2] This "journal", published by the South African Bureau of Racial Affairs (SABRA) has been described by one British academic as consisting "entirely of pseudo-scientific propaganda supporting apartheid" (Billig, 1979). SABRA's mission was, *inter alia*, to "influence people who are in positions of responsibility relating to our racial problems and the creation of a good relationship between the different population groups" (South African Bureau of Racial Affairs, 1949b:1*). The intellectual core of SABRA at its formation was the faculty of the Department of Bantu Studies at the University of Stellenbosch, who wanted to undertake the "scientific study of our country's racial questions, the propagation of sound racial policy, and research into racial affairs" (South African Bureau of Racial Affairs, 1949a:3*).

> or hundred years – the Natives will have to be put into a position where they are themselves responsible for their well-being. (Sadie, 1950:8)

Sadie also echoed Theal's sentiments from almost half a century earlier on the absence of a colonialism-precipitated demographic setback for the African population of South Africa:

> South Africans did not, and cannot, follow the example set by some of our overseas cousins, who, when colonising new territories, simply eliminated their problem on arrival; actively by means of fire-arms and fire water and, passively, by refraining from preventing the spread amongst the aborigines of disease, which although endemic in the Old World, assumed the character of epidemics in the new. (Sadie, 1950:7)[3]

By 1950, the concept of swamping, the need for the separate development of Africans and the formulation of African population growth as a distinct 'problem' requiring a 'solution' were firmly embedded in a single discourse of racial politics which became increasingly influential in the formulation of government policy. This discourse can be found in the section of the South African yearbooks, almost unchanged between 1958 and 1978, entitled "South Africa's multiracial population":

> A contradistinction: In many parts of the world, contact with European civilisation caused the disappearance of the indigenous populations…Under the benevolent care of their White rulers, the non-Whites in South Africa not only survived the impact of White civilisation, but began to increase at such a rate that they now outnumber the Whites 3:1. In consequence, a complicated population pattern has developed, which has brought in its train delicate political and social problems, the like of which few other countries have to face. (South Africa, 1958:53)[4]

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[3] Sadie shows some disregard for historical fact here, since the early Dutch settlers had hunted the Khoi and the San almost to extinction.

[4] Subsequent editions (see, for example, South Africa (1965, 1978)) retained almost exactly the same wording, replacing "White rulers" with "the Whites" and changing the ratio to 4:1. In keeping with the need to legitimise the process of granting independence to the bantustans, later editions also changed "multiracial" in the chapter title to "multi-national".

Following Sadie's lead, a dominant view emerged that a decline in African fertility could be brought about by containing Africans on their 'own' land, and forcing them to become reliant on their 'own' resources, and thus allowing ecological and Malthusian pressures to run their course in reducing African population growth. Implicit in this notion, of course, was that – with self-governance being granted to the bantustans – the effect on White South Africans of high rates of African population growth in these areas would be diminished, since the homelands would be politically and administratively independent of the Union. One proponent of these views was Bruwer (1954), who argued in an article in the *Journal of Racial Affairs* that encouraging Africans to adopt parity-specific fertility limitation would be futile:

> … it is clear how utterly difficult it will be to change the reproductive philosophy of the Bantu… It is generally accepted that industrialisation exercises a retarding force on population growth. In the South African pattern of industrialisation, this proposition probably does not hold for the Bantu. In the first instance, the economic pattern does not affect the way of living of the entire Bantu population … The economic pressure, lack of space and housing etc. that tends to retard White population growth in industrial areas, does not therefore have the same effects on the Bantu population because they, in addition to the living possibilities in the White sector, can also enjoy the advantages of their own reserves.
>
> Secondly, the mortality rate among the Bantu continues to fall as a result of better medical and other facilities … As the death rate among Bantu children falls as a result of improved living standards, the mean number of children per family will thus probably overtake that of Whites…
>
> …The pattern of South African food production is, to a large extent, one-sided. Although the Bantu, as the largest component of the population, also contribute to the production of food, this contribution happens largely in the White areas. Native reserves constitute about 13% of the total surface area of South Africa. Virtually all these areas lie in good rainfall areas, but they are not only undeveloped and unproductive, but are being robbed of their productive potential by primitive methods and overcultivation. In the meantime, the White areas must employ their carrying capacity to saturation point in order to provide food for the majority of the Bantu population.
>
> This one-sided burden on the land in respect of food production as well as industrial development shows the roots of our immediate population question to be both economic and sociological. Large-scale and planned development of the Native reserves is, without a doubt, a more realistic approach to

> our current population problems than the illusion of a quantitative population policy that, if it is applied, will make reproduction just as one-sided in the coming decades as the current arrangements in respect of production. (Bruwer, 1954:21-23*)

At about the same time, Sadie (1955) suggested that an alternative solution to the threat of "swamping" would be to encourage White immigration, an idea first mooted by Badenhorst (1950). However, Sadie acknowledged that such a policy (implemented in the 1950s, resulting in the immigration of large numbers of Whites, particularly from the United Kingdom) was unlikely to rebalance the racial composition of the country to any significant degree:

> It seems fair to conclude that there is a more than average probability that the Bantu population will grow at an increasing rate in the near future. This coupled with the fact that their multiplicand is so much larger than the corresponding multiplicand of Whites, means that the excess in number of Bantu over White will grow cumulatively … [O]n the basis of very reasonable assumptions with respect to growth and urbanisation, and assuming that future policy does not stop the flow to the present urban centres, there will be [two or three times more Bantu than Whites] unless we embark on a policy of large scale White immigration. Even so, the disparity in numbers cannot possibly be eliminated by means of White immigration. (Sadie, 1955:47)

Bruwer's argument, however, is noteworthy for the fact that it represents one of the first applications of the emergent theory of development via modernisation (and its demographic counterpart, demographic transition theory) to the South African context. However, even in 1954, this interpretation of modernisation theory was being subverted by the pressures of racial politics: modernisation of Africans was seen increasingly as occurring within the spatial and political realm of the bantustans, rather than within the White areas of South Africa.

More importantly, though, his arguments established the conceptual framework that dominated official demographic analysis in the country for the next thirty years. By paying little attention to the effects of the social and institutional characteristics of the South African polity on demographic outcomes, the inhibiting effects of apartheid polices on fertility decline were generally ignored, and the structure of South African society was treated as conceptually and theoretically unrelated to the process of fertility decline. The formulation and maintenance of this conceptual separation meant that subsequent analyses of the causes and consequences of rapid African population growth neglected to investigate the effects of apartheid institutions on African fertility. However, segregationist policies preserved (and, indeed, were intended to preserve) urban Africans' links with the bantustans, and hence limited the fertility-inhibiting effects of urbanisation in the White areas, while modernisation of the bantustans was contingent on expensive infrastructural and development programmes.

In 1954, this conceptual separation was less problematic than it would become. The homelands policy had yet to be fully developed and the principles behind "Bantu education" had yet to be fully implemented (although the Bantu Education Act had been passed a year earlier[5]). Moreover it is, at least theoretically, possible that large-scale industrialisation of, and investment in, the bantustans might have had the desired effect of promoting modernisation, and consequently fertility decline.

5.2.1 The Tomlinson Commission (1951-55)

The Commission for the Socio-Economic Development of the Bantu within the Union of South Africa[6] (South Africa, 1955) was a further milestone in the integration of population concerns into a broader social and political framework for South Africa. The Commission's terms of reference were set out in very general terms: to "conduct an exhaustive inquiry into and to report on a comprehensive scheme for the rehabilitation of the Native Areas with a view to developing within them a social structure in keeping with the culture of the Native and based on effective socio-economic planning" (South Africa, 1955:xviii).

With this remit, the Commission could not but stray into matters of population policy, and in particular the link between modernisation and economic growth on the one hand, and population growth and the need to limit African fertility on the other:

> …it cannot be assumed that [Africans'] attitude towards reproduction will change quickly enough in a spontaneous manner to realise the fruits of economic development in the form of a higher material standard of living… What is indicated, therefore, appears to be a campaign for the promotion of planned parenthood. (South Africa, 1955:30)

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[5] In a now-infamous speech in the Senate on the 1953 Bantu Education Act, HF Verwoerd had argued that "[T]here is no place for [the African] in the European community above the level of certain forms of labour… It is of no avail for him to receive a training which has as its aim the absorption in the European community, where he cannot be absorbed. Until now he has been subjected to a school system which drew him away from his own community and misled him by showing him the green pastures of European society in which he was not allowed to graze". (Verwoerd, 1975(1954):266)

[6] Hereafter referred to as the Tomlinson Commission.

However, in the concluding chapters of the Commission's Report, the call for a family planning service had been toned down into a recommendation that "an investigation into the possibilities of such a campaign [for the promotion of planned parenthood], should be undertaken" (South Africa, 1955:207). This modification probably resulted from the strong objections of Afrikaner theologians in the Dutch Reformed Church (to which almost all Nationalist politicians belonged, and described by O'Meara (1996:43) as playing "a crucial role in defining the moral parameters of the Nationalist agenda") to artificial family planning. As a result, even this (modified) recommendation was not acted on for another decade.

The "Native problem" as outlined by the Commission emphasised the numbers game in terms redolent of Hertzog's fears: "of all factors, the numerical relationship [between Whites and Africans] is probably the one which counts for most". As a result, the Commission argued that giving equal right to Africans would endanger "the existence of the European and his civilisation" (South Africa, 1955:9). The Commission's concluding recommendations summarised four years of work and almost 4 000 pages of the full report as follows:

> (i) A choice will have to be made by the people of South Africa, between two ultimate poles, namely, that of complete integration and that of separate development of the two main racial groups. Taking all factors into consideration, the Commission recommends the latter choice, namely, separate development.
>
> (ii) The initial step towards the practical realisation of separate development of Europeans and Bantu, lies in the full-scale development of the Bantu Areas.
>
> (iii) The development of the Bantu Areas will have to embrace a fully diversified economy, comprising development in the primary, secondary and tertiary spheres. (South Africa, 1955:207)

The genesis of many apartheid policies implemented after 1960 can be found in the Report's recommendations that Africans be removed from so-called 'black spots', and its arguments in favour of the desirability of 'retribalising' Africans. As Posel discusses at length, changes in government policy on influx control and urbanisation represented the consequences of an ideological victory by the more conservative faction of the National Party under the guidance of the *Broederbond*, a secretive network of Afrikaner intellectuals, capitalists, administrators and theologians. Official policy on African urbanisation up until 1959 (under the Native Affairs Department) had sought to accommodate the growing demand for African labour in White areas. However, with the transformation of the Native Affairs Department into the Bantu Affairs Department, government policy underwent a marked shift. Whereas detribalisation (and permanent African settlement in urban areas) had been previously thought to be inevitable, the new approach actively sought to "curb white dependence on African labour in the cities" (Posel, 1991:228-9), and cast the need for independent homelands as being in the interests of the preservation of African culture.

However, as a result of that strong rightward shift (described in detail by O'Meara (1996:70-1)), the developmental aspects of the Commission's recommendations were generally ignored. Posel notes that the recommended "ambitious and expensive programme of agricultural, industrial and mining development", was estimated by the Commission to cost £104 million over the first ten years. However, "by the end of 1958 the government had allocated a mere £3,500,000 for reserve development" (Posel, 1991:126).

The extent of the political shift after 1960 was clearly visible in the realm of population policy too. The emergence of new political priorities in the wake of the political struggles within the ruling party set in place a set of contradictory approaches and policies towards African population growth and the need to reduce African fertility. The assumed importance of modernisation in reducing African fertility was replaced by a view that sought to solve the "native problem" by means of rigid social and spatial segregation and the granting of 'independence' to the bantustans. Doing so would also shift the burden of modernisation onto the new homeland administrations, and hence the cost of modernisation would not be borne by White South Africans.

Sadie's arguments that "the numbers must count", and his warnings of the dangers of African urban population growth resonated with the newly elected leadership of the National Party. In 1962, Prime Minister Verwoerd gave a speech in the (White) House of Assembly motivating strongly for the Transkei to be given its independence. Failure to do so would lead to the swamping of White South Africans in the Republic, he argued, and quoting Sadie directly, "… it would inexorably lead to Bantu domination. Because in the long run numbers must tell." Verwoerd continued with the bluntest possible threat of not granting independence to the homelands: "And I say it unequivocally that the people of South Africa cannot accept the consequence of having a multi-racial state unless the Whites, the Coloureds and the Indians are prepared to commit race suicide" (Verwoerd, 1978 (1962):179-180).

The prospect of White "race suicide" reached its apogee in 1967 when MC Botha, Minister of Bantu Affairs, launched a campaign to encourage White South Africans to increase their fertility through tax relief and other benefits, and "have a Baby for Botha". Contrary to Kaufman's assessment (1996:32) that this call went unheeded (its sole, and unintended, effect according to her being a reduction in attendance at non-White family planning clinics), the campaign may have had a marginal impact on White fertility. According to Mostert (1979), total fertility among Whites in 1965 was 3.08 children per woman and that in 1970 was 3.09. White fertility had been in decline for some time, and the apparent stasis between 1965 and 1970 (total fertility had dropped to 2.58 children per woman in 1974) could mean that while the programme did not <u>increase</u> White fertility, it did – for a while – halt its decline. Further evidence in this regard is that between 1965 and 1970, the age-specific fertility rates for White South Africans actually increased in the 25-34 age group, while declining in all other age groups. Women in these age groups would, presumably, have been most susceptible to the campaign's message.

As Greenhalgh (1995b) has observed, 'classical' demographic transition theory shares many of the same tenets as modernisation theory, particularly in relation to the process of fertility decline. In parallel with their hypothesised significance for modernisation, education (especially that of women), wage employment and urbanisation were all assumed to be important, even if neither necessary nor sufficient, in the transition from high to low fertility. The rise (and acceptance by apartheid planners) of the modernisation thesis, with its emphasis on development as a determinant of demographic transition began to highlight some of the contradictions inherent in government policy in the mid- to late 1960s.

With the rejection of the developmental aspects of the Tomlinson Commission's recommendations, government policies after 1960 had the explicit intent to limit African urbanisation and to restrict their participation in the labour force. The education of Africans, too, was seen as being of minor importance. The government's desire for Africans to maintain strong links with the bantustans, coupled with the increasingly draconian system of forced removals to the homelands, thus greatly restricted the extent to which modernisation might precipitate a decline in fertility.

Furthermore, these policies were seen to obviate the need for significant modernisation and development of the African population in White areas (since Africans were not supposed to be there). Equally, the desire to grant political autonomy to the bantustans meant that their underdevelopment was construed as a matter outside the ambit of government policy.

In the absence of either socio-economic development or family planning programmes, African fertility unsurprisingly remained high in White areas, further increasing White fears of being swamped and leading to louder calls for even more rigid patterns of spatial separation along racial lines.

If apartheid demographers and ideologues were aware of the incompatibility of government policy with modernisation theory, this was not stated openly. Instead, African population dynamics were increasingly discussed in isolation from the broader social, economic and political context of the South African polity (much as Bruwer had done in the 1950s). This allowed lip service to continue to be paid to the benefits of modernisation theory, while not engaging with the negative effects of government policy on the viability of a modernisation-led fertility transition. Thus, the result was a curiously naïve framing of the terms of the debate within government on population policy in South Africa, taking as axiomatic the preservation of the *status quo*, particularly the need for separate development, the necessity and desirability of maintaining the bantustans as quasi-independent entities, and the desire to control the migration of Africans to White urban areas.

5.3 Contradictions in the modernisation thesis, population control and family planning: 1968-1974

Towards the end of the 1960s, two international developments helped to deflect attention from the increasingly obvious contradictions between the government's desire to reduce African fertility through modernisation and its espousal of policies that denied the beneficial effects of modernisation to most African South Africans. The first was the publication of Paul Ehrlich's book (Ehrlich, 1968), with its alarmist prognostications of overpopulation and resource shortages; the second was the support lent to family planning programmes by the international community from the 1960s onwards.

Ehrlich's work proved a boon for South African demographers in the late 1960s and early 1970s. Not only did the notion of the "population bomb" reflect their own concerns about Whites being swamped by the higher fertility of Africans but the explicit threat of overpopulation (especially urban crowding) and environmental degradation provided additional justification for the extension of apartheid policies, and the desire to grant independence to the bantustans. The significance of the "population bomb" metaphor, and the alacrity with which it was adopted, cannot be understated.

The metaphor of the "population bomb" was most clearly expressed at a symposium organised by the South African Medical Association in October 1971 on the "Population Explosion in South and Southern Africa". An indication of the seriousness with which the government viewed the matter is given by the fact that, of the nine papers delivered at the symposium, senior ministerial officials gave four, including an opening address by Dr Connie Mulder, then Minister of Information. The theme of Whites being swamped was elaborated and found a new voice in the rhetoric of the population bomb:

> The Whites increased by about 662 000 from 1960 to 1970 as against a total Non-White increase during the same period of 4 782 000. That means for each White person added to the South African population, there was a corresponding increase of 7.2 Non-Whites… The conclusion to be drawn from the above is THAT THE WHITES ARE A DWINDLING MINORITY IN THE COUNTRY. (Dr C. J. Claassen in van Rensburg (1972:7), original emphasis)

Not only were Whites in imminent danger of being swamped but, with judicious choice of comparisons, it was possible to claim that "South Africa's population is increasing at the highest rate in the world" (van Rensburg, 1972:10). The implications of this growth for the South African polity were terrifying: high rates of African population growth would tilt the numerical balance of the population further in favour of Africans, thereby threatening still more any vestige of legitimacy for White control.

The metaphor also appeared increasingly frequently in reports on population growth and fertility in South Africa produced from 1968 onwards. These reports tended to commence with an introductory chapter outlining the 'problem', and establishing that if the population explosion carried a threat for the planet *en masse*, the threat was notably worse for White South Africans. After setting out the rates of global population growth from pre-Christian times and comparing the rates of population growth in developed countries relative to developing countries, these reports would then focus on South Africa, its high rate of (African) population growth, and conclude with a jeremiad that Africans would not, or could not, limit their fertility[7].

References to the "population bomb" could be found also in government reports throughout the early 1970s. In a set of population projections based on the 1970 census published in 1973, for example, projected African population growth over the next forty years was described as "explosive" (Mostert, van Eeden and van Tonder, 1973b:11*).

The new family planning paradigm, based on fertility reduction through the provision of family planning services, offered a way of resolving the incompatibility between apartheid policies and the perceived need for modernisation to deliver rapid fertility decline among Africans. Calls for a family programme directed at Africans grew louder from the late 1960s, despite concerns expressed in parliament that the adoption of family planning programmes might open the government up to charges of "racial murder" or even genocide (Kaufman, 1996:35-37). These concerns (even though they were periodically expressed over the next few years) were increasingly dissipated by the international support given to the implementation of family planning programmes across the developing world, and the belief in the possibility of a contraception-driven fertility transition.

Thus, in his speech to the 1968 SABRA congress, Dr PM Robbertse, the chair of the Human Sciences Research Council (HSRC), was among the first South Africans to publicly invert the original formulation of the modernisation hypothesis by arguing that African socio-economic development was being compromised by high rates of population growth. In keeping with the congress' theme, however, he paid greater attention to the promotion of White fertility. Using Nazi Germany as his principal example, he proposed that White fertility should be increased through incentives to marriage (in the form of state transfers), further substantial transfers in respect of third, fourth and higher order children, and subsidisation of housing and tertiary education for large families. However, he was at pains to point out the necessity of family planning programmes for Africans, too:

[7] The clearest examples of how this discourse was used are found in Cilliers (1971), Lötter and van Tonder (1976) and Schutte (1978). Similar instances are found in many of the papers, especially Robbertse (1969), presented at the 1968 South Africa Bureau of Racial Affairs congress in Bloemfontein, whose theme was "White Population Growth". These papers can be found in *Journal of Racial Affairs* (1969), Vol. **20**(1).

> A population policy for the Non-Whites is as urgent as one for Whites … If the birth rate of the Non-Whites is to fall, it would have the advantage that the proportional increase of the various population groups would become more equal … it would also have the benefit of allowing the living standards of the Non-Whites to rise much faster.
>
> I am not prepared to guarantee that the proposed, or similar, measures will increase the White birth rate. I am, nevertheless, prepared to guarantee that this rate will decline further, unless attempts are made to halt the trend. Therefore, I am in favour of a population policy. Even if the measures only halt the trend, it would still be worth the effort. And these measures will promote social justice by easing the burdens that are placed on the large family. Along this road, the quality of the population will be raised.
>
> The time has also come to formulate a comprehensive population policy for the Non-White population groups, and I make the proposition that the majority of the Non-Whites would welcome such a policy… (Robbertse, 1969:61-62*)

From early in the 1970s, apartheid-supporting academics and administrators had to come to terms with the demographic consequences of the government's failure to modernise the African population. In response, they began to reformulate government population policy in a manner that attempted to square the contradictions between modernisation and apartheid, and simultaneously embrace the new family planning paradigm.

One tendency, most coherently represented by Jan Sadie and SP Cilliers, followed on from Robbertse, elaborating on the inversion of the modernisation hypothesis, and calling for immediate action to implement a family planning programme and a revision of existing population policy. Their solution reversed the central argument of the modernisation hypothesis and demographic transition theory, and – instead – proposed that socio-economic development of the bantustans would only be possible if the rate of population growth was slowed significantly. Modern contraception offered an ideal mechanism for doing so.

Thus, for example, Sadie (1970, 1973) argued for the introduction of a "vigorous" family planning campaign, while still pushing for increased 'decentralisation' of the South African economy. Decentralisation was, broadly speaking, a euphemism for forced removals and stronger spatial and economic segregation of Black and White in

South Africa. In particular, the decentralisation policy aimed to promote the growth of (White-owned) industry within the bantustans, or on their periphery, thereby creating employment opportunities for Africans in or near the homelands, while increasing the scope for removing 'surplus' Africans from the White cities. In 1970, Sadie concluded a review of demographic data on Africans with the opinion that the African population would "remain in the explosive phase, unless a vigorous family planning programme [was] successfully conducted" (Sadie, 1970:190). Three years later, in the commentary on a frequently cited series of population projections, he took a fairly pessimistic view of the potential for African fertility to decline. With a projected level of fertility of 5.2 children per woman for 1990-1995 and 4.1 for 2010-2015, he estimated a need by 2000 for new or existing cities to accommodate an additional 28 million inhabitants, and called for faster industrial decentralisation to reduce this growth, while noting again the additional need for a "sustained and vigorous family planning programme". Failure to implement such a programme, in his opinion, would result in an ever-diminishing proportion of Whites and Asians (who "provide the major proportion of entrepreneurial initiative"). This dilution would then further impoverish Africans and Coloureds (and inhibit the decline in their fertility), since they have "for practical purposes, only their labour to offer whose employment is dependent upon the enterprise and capital supplied by the other two groups" (Sadie, 1973:37-8). Thus, by the early 1970s, White demographers had ceased to believe in the possibility of a neo-Malthusian solution to the problem of African population growth.

Cilliers (1971) took a similar view to Sadie, arguing that high population growth was retarding the "upgrading" of the African population. Consequently, the "need for population control" was based on the belief that modernisation was impossible without a prior fertility decline. Like Sadie, Cilliers called for the family-planning paradigm to be closely integrated into a broader programme of socio-economic development in the bantustans. In his monograph, "Appeal to Reason", an entire chapter was devoted to "The need for population control":

> …I am convinced that the time has arrived for South Africa to formally and openly aim at population control through family planning. We must, without delay, incorporate a population programme into our broad programme for social and economic advancement for all sectors of our society. In fact, it cannot be disputed that without such a population programme, which should consciously and openly strive towards motivating all

> sectors of the community to limit family sizes in accordance with the ability to provide adequately for dependants and towards providing all sectors of the community with the knowledge and means of implementing fertility control, we will not succeed in our efforts at social and economic advancement for the masses. (Cilliers, 1971:79-80)

The centrality of demographic concerns in the formation of government policy, and the importance of demographers to this, became increasingly evident in the early 1970s. For example, in a subsidiary report to the HSRC's 1973 projections, Mostert, van Eeden and van Tonder actively argued the case for further removals of Africans from White areas:

> [i]n the case that only the current homeland populations, together with their natural increase, must be kept in these areas, economic development must at least keep pace with population growth. However, the ideal must rather be for homeland development to take place at such a rate that a much larger volume of Bantus will flock out of the White areas to the homelands than the natural increase of [those Bantu in the White Areas]. … Even to be able to restrict the numbers of the [Bantu in White Areas] to the 8.2 million in 1970, more than 200 000 Bantus will have to be resettled in the homelands each year. (Mostert, van Eeden and van Tonder, 1973a:3*)

The threat posed by African population growth to the political integrity of White South Africa was picked up on by contributors to the 1972 symposium. Modernisation of the bantustans, it was argued, was essential to maintain the integrity of White South Africa. Thus, for example, van Rensburg (1972) argued that

> [t]he more successful the policy of separate development is, (with the concomitant increase in the percentage of Whites in the White areas), the more successful the policy of the development of the homelands will have to be… In view of existing government policy, the possibility of no African emigration from the White areas in the years to come will not be considered, because such an eventuality would be tantamount to the total collapse of the present policy of separate development, an event which the author cannot or will not predict. (van Rensburg, 1972:13)

However, these views held their own contradictions: if van Rensburg could not countenance the failure of the government's influx control policies, he was also aware that the homelands were incapable of supporting the projected African population, thereby leading to possible further demands for Whites' land by Africans and still greater threats to White domination:

> A situation could very well arise where the Whites would have to safeguard their land by force of arms. In the best interests of all the people of South Africa it is imperative that the evil political consequences of a chronic and ever increasing African land hunger (a direct result of their uncontrolled proliferation), should be avoided at all costs. (van Rensburg, 1972:14)

The 1972 symposium reflected an elaboration and sophistication of official thinking on the population question. Van Rensburg attacked the past discourses on population as being a "dualistic White view which seeks to generate an increased growth of the White population and, at the same time strives to bring about a drastic reduction in the growth of the Non-Whites" (van Rensburg, 1972:94). He argued that it was implausible to expect White fertility to increase to the rates required to stabilise its constituent proportion of the South African population. Second, even though a national family planning programme aimed at all population groups might precipitate a further decline in White fertility, he argued that in absolute terms the formulation of such a programme would decrease African numbers more than they would those of Whites. Third, he recast earlier White fears of being accused of genocide by arguing that Africans would refuse to limit their fertility on such terms:

> Stated in plain language, they could argue: We do not see our way clear to committing racial suicide while you Whites are actively encouraged to have larger families … This understandable Non-White attitude (the result of the Whites' dualistic approach) can have only one conclusion – an increasingly uncontrolled Non-White population growth causing, in turn, two inevitable results: ultimate and unavoidable "swamping" of the Whites and a rapid and ultimately disastrous drop in the Non-Whites' standard of living until widespread famine and misery step in to restore the balance. The results of the White's dualistic views can be summed up as suicide for the Whites, and indirectly suicide for the Non-Whites too. Strongly stated perhaps, but unfortunately the sober truth. (van Rensburg, 1972:96)

These calls from academics within the ruling party and generalised White concern about African population growth, together with the growing international support for the family planning movement, no doubt encouraged the South African government to launch its National Family Planning Programme in 1974. However, according to government officials, the decision to launch the programme and make contraception available was driven by a growing demand for contraception from African women

(Mostert, 1978). While the public face of the campaign might have suggested that the programme was demand-led, the National Family Planning Programme was plainly not simply a response to that demand, as Mostert makes plain:

> the introduction of a (family planning service) in South Africa was stimulated by growing genuine demand. This was, in truth, not the only reason. From the beginning, too, the government viewed the programme as a mechanism for hastening the socio-economic development of the population. (Mostert, 1978:86*)

Thus, by the end of the 1970s, interpretation of the modernisation-fertility nexus had come full circle. While the Tomlinson Commission had recommended in 1955 that fertility decline would come about through modernisation, by 1974 the government was advocating the exact reverse: modernisation through fertility decline. This volte-face however, should be understood in the context of the inversion of demographic transition theory that occurred in the early 1950s, as discussed in Chapter 2.

Family planning services had been available to Africans, albeit unofficially and mostly in urban areas, since the mid-1960s, and Mostert's claim that there was a "genuine demand" for family planning among African women is probably correct. Government surveys on family formation conducted in late 1969 and early 1970 in the four major metropolitan areas of the country had shown low levels of current use of modern contraceptive methods, but a high degree of desire for further information (although this simply may be the product of using a leading question), as Table 5.1 and Table 5.2 show.

Table 5.1 Percentage of fertile married African women in 1969-70 wanting more information on contraception, by age and city

City	*15-24*	*25-34*	*35-44*
Durban	77	73	53
Johannesburg	80	84	75
Pretoria (all ages)		-----70------	
Cape Town (all ages)		-----84------	

Source: Mostert (1972); Mostert and du Plessis (1972); Mostert and Engelbrecht (1972); Mostert and van Eeden (1972)

Note: The definition of "fertile" here is that used by the authors. It excludes women who are definitely or probably infertile (no use of contraception, and no conception in the past decade), as well as those deemed semi-fecund (no conception in the absence of contraceptive use in the last two to three years)

Five years later, shortly after the official announcement of the 1974 National Family Planning Programme, a national survey[8] on family planning use and fertility among Africans found much higher rates of current use of modern contraceptive methods among urban women meeting the same fertility criteria. 29 percent of fertile urban African women aged 15-24; 33 percent of those aged 25-34 and 27 percent of women aged 35-44 were then using some form of effective contraception (Lötter and van Tonder, 1976).

Table 5.2 Percentage of fertile married African women in 1969-70 using contraception, by age and city

City	*Age group*	*Not using*	*Modern methods*	*Traditional methods*	*Modern and Traditional*
Durban	15-24	74	8	18	--
	25-34	72	14	15	--
	35-44	82	6	12	--
Johannesburg	15-24	76	18	6	--
	25-34	66	24	10	--
	35-44	79	16	6	--
Pretoria	15-24	74	15	10	1
	25-34	71	13	14	1
	35-44	68	16	16	0
Cape Town	15-24	50	22	18	9
	25-34	41	22	22	16
	35-44	56	18	17	9

Source: Mostert (1972); Mostert and du Plessis (1972); Mostert and Engelbrecht (1972); Mostert and van Eeden (1972)
Note: The definition of "fertile" is as in Table 5.1

Thus, over the five years before the official launch of the National Family Planning Programme, contraceptive use among urban African women had increased quite dramatically. The desire for further information about contraception noted in 1969 and 1970, and the subsequent rise in current contraceptive use (much of which happened without the benefit of a co-ordinated government programme), provides some indication that by the early 1970s a fairly strong demand for contraception had evolved, at least among urban African women.

The programme expanded rapidly after its official endorsement in 1974. By 1977, there were more than 2 700 clinics in (the White areas of) South Africa where contraceptives were available, and nearly a quarter of a million women were visiting

[8] The survey covered all 'homeland' areas, but did not sample any Africans living in the Western Cape. One of the recommendations of the Tomlinson Commission was that the Western Cape be declared a Coloured "Labour Preference Area". Accordingly, Africans were not supposed to be resident there. Hence, one suspects, Africans were not sampled in the Western Cape, since doing so would be tantamount to an admission that the policy of influx control in the Western Cape had failed.

these clinics every month[9] (Mostert, 1978), leading Caldwell and Caldwell (1993) to describe the programme as being "super-Asian" in its intensity. However, as shown in Chapter 3, widespread contraceptive use did not translate into a rapid decline in the level of African fertility, nor did it have a discernible effect on women's fertility intentions. Reasons for this lack of effect are proposed in Chapter 6.

5.4 From the National Family Planning Programme to the Population and Development Programme: 1974-1983

Compared to the early 1970s, research on African fertility almost ceased after publication of the report on the 1974 fertility survey. What little research was conducted tended to avoid dealing with the inconsistencies of apartheid policy vis-à-vis population growth, and concentrated instead on the social and financial implications of continued African urbanisation (see, for example, Schutte (1978)).

Several reasons can be suggested for the relative paucity of substantial demographic research in the period after 1974. First, the National Family Planning Programme represented an end in itself. Given the sheer weight of argument within the ruling elite that such a programme was the only way to ensure White survival and limit African fertility, it is perhaps unsurprising that, until the programme was evaluated, few further data were collected. Second, with the granting of 'independence' to four homelands over the following decade, data sources became increasingly fragmented. No census for the entire Republic including its homelands was conducted again until after 1990, and collection of demographic data had to rely on co-operative ventures with homeland administrations. As a result, the usefulness of the WFS-type survey conducted in 1982 (van Tonder, 1985) is limited by the fact that data were collected only in the 'White areas' of the country. In addition, political unrest after the Soweto uprising of 1976 and its consequences undermined the legitimacy, the capacity and (probably) the desire of government authorities to conduct research into the demography of the Black population of South Africa.

A commentary on population growth published by Mostert in 1979 employed the device first used by Bruwer in 1954, paying much attention to the effects of high African fertility and ignoring the possible structural causes of that high fertility induced by apartheid policies:

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[9] It is unlikely that many of these women were White, since most White women would have received contraceptive advice from their (private) general practitioner.

> In the White areas of South Africa, where more than half of Blacks are urbanised, and where a strong family planning programme is being pursued, it can be expected that that the birth rates will fall quickly, but in the Black areas it is probable that the birth rates will decline only slowly – on account of the lack of dynamism in their family planning programmes on the one hand, and the low rate of modernisation and urbanisation on the other. (Mostert, 1979:38*)

It is difficult to credit that a demographer of Mostert's standing was oblivious to the retardant effects of apartheid on the fertility transition in South Africa, or to the reasons behind the "low rate of modernisation" and the "lack of dynamism" of family planning programmes in the homelands. The more plausible explanation is that he constructed the argument thus because any deeper analysis would expose the full extent of apartheid's contradictions with the theory and practice of modernisation.

In almost all respects, the period from the early 1970s to the mid-1980s was a difficult one for apartheid ideologues. The relatively high rates of economic growth that had been achieved in the 1960s fell away. Organised African labour power asserted itself for the first time in a generation in the 1973 Durban Strikes. The 1976 uprising, led by students protesting against the forced teaching of Afrikaans in schools, marked the end-point of a period when the balance of power tilted briefly against the state. A period of relative quietude followed the suppression of the 1976 riots.

Despite the continued application of the Pass Laws and the granting of autonomy to homelands (often whether they wanted it or not), the underlying social fabric of South Africa was beginning to change fundamentally. Since 1973, African wages had increased sharply relative to those of Whites. In 1979, the Wiehahn Commission recommended allowing the formation of African trades unions (albeit under restrictive conditions). PW Botha's accession to power in the 1978 election marked the onset of a new era, frequently referred to as being characterised by "reform and repression" under which piecemeal legislative reform was made while the state simultaneously increased its internal security apparatus under the guise of the threat of the "Total Onslaught", a catch-all phrase, covering supposedly Soviet- or Marxist-inspired "social and labour unrest, civilian resistance, terrorist attacks against the infrastructure of the Republic, the intimidation of Black leaders and members of the security forces" (O'Meara, 1996:264-5).

In late 1981, the President's Council commissioned a report from its Science Committee with a brief to examine, *inter alia*, "the extent to which the economic and social development, the quality of life and the productivity of the population of the Republic of South Africa, are significantly being harmed by the population growth and population structure, now and in the future" (South Africa, 1983:foreword). The final report[10], submitted in March 1983, provided the blueprint for the South African population policy that followed, as well as providing important signs that apartheid intellectuals were aware that the apartheid edifice was in danger of crumbling.

The historical and political context in which the report was written is of particular importance. Later that year, White South Africans were to be asked to approve the dismantling of the Westminster-style parliament, replacing it with a tricameral system, one house for each of the Whites, Coloureds and Asians/Indians. Africans were still to be denied any form of parliamentary representation. The introduction of the tricameral system precipitated the launch of the United Democratic Front as an internal front for the then-banned African National Congress, and ushered in seven years of internal instability (and successive States of Emergency) that culminated in the start of negotiations with the ANC about a future dispensation in 1990.

In many respects, the President's Council Report is a masterpiece of obfuscation, allowing its readers to interpret it in a huge variety of ways. On one level, it is apparent that – in common with so much demographic research in South Africa from the 1950s onwards – the authors had struggled from the outset to avoid contradiction. In a comment on educational levels in the country, for example, bland assertions of fact ("the general level of education of Whites is considerably higher than that of the other three population groups…" (South Africa, 1983:24)) are made with little or no attempt to explore the underlying reasons behind those facts or criticise the structural iniquities caused by apartheid policies. Elsewhere, the report noted that

> Of importance, moreover, is that the *lowest numbers of children* occur in families *which are urbanised*; in which *both husbands and wife have reached a high level of education*; and in which *the wife is employed outside the agricultural sector and outside the family.* (South Africa, 1983:74-75, original emphasis)

Thus, the separation of the links between cause and effect that was so necessary in earlier years was again needed to mask contradictions between the consequences of

[10] Hereafter termed the President's Council Report.

apartheid policies and desired demographic outcomes. However, despite the contradictions that modernisation theory now held for apartheid South Africa, and despite the adoption of the family planning model and the inversion of the population-development argument in the 1970s, the converse was still believed to be of significance: "*population growth in all countries is related to development and modernisation*" (South Africa, 1983:64, original emphasis). To avoid the obvious contradiction between modernisation and apartheid policies, this absolute statement was then qualified:

> The conclusion arrived at is not that fertility is not related to modernisation and development – it is abundantly clear that it is – but rather that there is a loose relationship that differs between regions, countries and cultures. (South Africa, 1983:68)

Despite the implementation of, and support given to, the National Family Planning Programme, and the high levels of contraceptive use (the President's Council Report itself claimed a 45 percent current use rate in Soweto in 1980), the report opined that Africans were not capable of adopting modern contraception on a large scale to reduce fertility due to their not being sufficiently modernised, and the "psychological climate" among Africans not yet being "favourable":

> The continuing high fertility and low usage rates of modern contraception can be attributed largely to a combination of low levels of modernisation, or socio-economic status, and accessibility of modern contraceptive services, particularly in the rural areas where about two-thirds of the Black population lives. In contrast with the Asian and Coloured populations, the level of socio-economic development and the psychological climate among Blacks are not yet favourable enough for modern contraceptive usage to be accepted on a large scale and to be conducive to rapidly declining fertility. (South Africa, 1983:103)

Once again, high African fertility is explained by the failure of modernisation, rather than a deeper analysis of the constraints on the potential for modernisation to work imposed by other apartheid policies. However, had apartheid demographers analysed the changing pattern of birth intervals that were then becoming apparent, they might have reached very different conclusions, since these would have shown that African women were adopting modern contraceptive methods, but were not using them in the manner desired by the government.

At another level of analysis, the report attempted to justify some of apartheid's more grotesque social engineering in terms of international trends and policies: "policy measures relating to population redistribution are applied by 95% of the governments of developing countries" (South Africa, 1983:7).

Finally, the report reads as a damning internal indictment of apartheid policies and their retardant effect on African fertility decline, acknowledging the existence of the contradictions outlined above. These criticisms are found predominantly in the Report's recommendations and, in effect, call for the dismantling of the apartheid edifice. In this regard, however, the report is more tentative, as if the authors were uncertain how President Botha and his cabinet would receive the conclusions drawn. For example, despite "the determined attempts by the government to limit flocking to White areas" (Schutte, 1978:83*), the President's Council Report viewed the urbanisation of Africans as "inevitable and universal". At the time of the Report, the proportion of the African population in urban areas had increased only slightly – from one third at the time of the 1970 census, to 38 percent in 1983. Thus, although influx control had limited and controlled urbanisation to a considerable extent, the Report concluded that the maintenance of influx control was no longer possible (South Africa, 1983:33).

The President's Council Report also presented data showing a decline in the level of African fertility from 6.8 in 1955 to 5.2 in 1980 (a 23 percent reduction in fertility – more than twice the 10 percent generally accepted as heralding the onset of an irreversible fertility transition). Despite this decline, in one of the more significant passages, the third chapter of the Report concluded that "in the case of the Blacks, only a *slight fertility decline* has occurred" (South Africa, 1983:105, original emphasis). Three of the seven reasons given for that slow decline focused on the administrative deficiencies of the National Family Planning Programme, including its lack of integration into other social and development programmes, limitations on resources (both human and material) and problems of communication across the various ministries, both in White South Africa and in the 'homelands'.

Two reasons blamed Africans for the failure, attributing to them "cultural resistance and ignorance, particularly among the tradition-bound Blacks", and holding "certain Black leaders" accountable for their politicisation of family planning. As the next chapter argues, this "inadequate piece of political analysis" (Timæus, 1984b) is, in many respects, disingenuous and incompatible with the high level of contraceptive use. In the context of an increasingly aggressive state and its hostility to criticism of any form, it is perhaps unsurprising that the report's authors attempted to shift some of the blame for the slow pace of the South African fertility decline onto Africans. This is not to deny that there was not politicised resistance to the government's family planning policy, but as shall be argued later, it is highly debatable whether this had any substantial effect.

The final two reasons for the slow decline (the second and third given in the text), are for the present purpose, the most interesting. They at least acknowledge the contradiction that had plagued South African population policy for so long, attributing the slow pace of decline to the "large percentage of Blacks who are still in underdeveloped areas" and the "relatively poor and underdeveloped socio-economic circumstances of rural and urban Blacks". While these observations echo those of Mostert (1979) quoted earlier, they represent the first official admission of the institutional context of fertility decline in South Africa. Nowhere are the underlying reasons for the slow decline in African fertility openly discussed, but the implications must have been clear to those who read the report: Apartheid policies had retarded the fertility transition among African South Africans.

5.5 The Population and Development Programme (1984)

The 1984 Population and Development Programme (PDP) was set up to implement the recommendations arising from the 1983 President's Council Report. The PDP offered a more coherent and holistic understanding of the dynamics of population and demographic change than the National Family Planning Programme it superseded. It afforded great weight to the presumed importance of social and economic variables in hastening a fertility decline, and recognised the need to remove some of the barriers to fertility decline caused by apartheid policies. The overriding ambition of the programme was to reduce national fertility to replacement levels (around 2.1 children per woman) by 2020. The principal motivation for this target was concern over the country's water supplies, which – it was felt – were incapable of supporting a population of more than 80 million. The target fertility rate, would on the basis of government projections, result in a stable population of around this size in 2100[11].

[11] It is interesting to note the return (after their rejection in the early 1970s) of this neo-Malthusian argument in the Report's justification of the need to limit population growth through a revised population programme.

For all of the concerns and awareness expressed in the President's Council Report about the effects of apartheid on retarding the fertility decline among Africans, the effects of the PDP were muted, as can be seen from the continued slow pace of fertility decline after 1984. In their assessment of the PDP, the Department of Welfare's White Paper of 1998 suggested that, while the PDP did consider the broader context of fertility decline in South Africa, the programme "did not address the fundamental question of the lack of citizenship of the black population, nor the institutionalised discrimination" prevalent in South Africa (Department of Welfare, 1998:3). Additionally, the failure of the PDP to meet its objectives were also attributed to its lack of integration into an overall development plan for all South Africans, the paucity of demographic data and demographic skills, and a failure of implementation at a provincial level. The validity of these criticisms notwithstanding, however, the continued uptake of modern forms of contraception after 1984, particularly in rural areas, is indicative that the PDP did, in some respects at least, succeed in broadening access to contraception and contraceptive advice.

5.6 Conclusion: Rhetoric and reproduction in apartheid South Africa

This chapter set out to provide a history of the evolution of rhetoric and policy on population in South Africa, paying special attention to the apartheid era. The changing political construction of demographic threats and realities in South Africa over the course of apartheid outlined in this chapter offers many insights into the process whereby South African population policy was formulated. In this regard, as in America and Europe, the dominant focus in South Africa during the inter-war years was on eugenics, and on improving the quality of the White population. By the end of the Second World War, however, discourse on population in South Africa reflected the (original) formulation of demographic transition theory. According to this version of the theory, modernisation and socio-economic development would lead to fertility decline, as the forces of Westernisation and economic growth began to undermine "traditional" patterns of social organisation.

As has been shown, following on from the espousal of modernisation theory, the first half of the 1970s saw the adoption of the rhetoric of the population explosion and the growing belief in the possibility of a contraceptive-led fertility transition. The changes in international development and demographic thinking that permitted this change were indeed timely in the context of South African population policy. The rightward shift in South Africa's internal politics in the late 1950s and early 1960s had led to the abandonment of a development-led approach to instigating a decline in African fertility as recommended by the Tomlinson Commission. Both locally and internationally, greater emphasis was placed increasingly on the retardant effects of rapid population growth and high fertility on modernisation and socio-economic development.

While rhetoric and policy on population in South Africa reflected international trends, these were not simply imported and applied unthinkingly to the South African context. Indeed, those international trends and theories were, in some senses, instrumental in providing apartheid policies with much-desired scientific legitimacy, even if the interpretation lent to those international trends and theories was not that intended originally. Thus, for example, even though the Tomlinson Commission had recommended a strategy of industrialisation to help limit African population growth, the Commission's recommendations were expressed in the language of apartheid policies: that that development should occur in a political and administrative sphere distinct from that of White South Africa.

Posel's descriptions of the internal conflict and compromise within the apartheid state are also borne out in population policy. The centrality of population – the "numbers must count" – to apartheid policies meant that population policy, particularly, was affected by internal conflict between various government ministries with competing aims and agendas, as well as being affected by changes in international demographic thinking. The internal conflicts waged within the ruling party created a host of legislative and administrative frameworks that were far from entirely consistent with each other. Accordingly, after 1960 it is hard to divine a clear set of policies on population that was implemented with any determination or coherence. In keeping with the need for quasi-scientific justifications of apartheid, the external face of many population policies reflected trends in the international development and demographic theories of the day. While these trends can be identified within the rhetoric and population policies adopted, the attempts to accommodate these within the broader structure of apartheid policies were generally heedless of any contradictions between them and government policy in other areas.

The adoption of the rhetoric of the "population bomb" and the arguments in favour of instituting family planning programmes in the late 1960s and early 1970s again indicate that – at least in the early and middle parts of the apartheid era – population policy in the country was broadly in alignment with that emerging in the United States. The fact that a particular path of evolution of official discourse on population questions so closely mirrored that in the United States is hardly surprising.

As Szreter (1993) has argued, the inversion of the development-fertility nexus in the United States in the early 1950s was driven as much by the need for demographic research to be relevant to policy formulation, as by the feared consequences of communist or socialist uprisings across the developing world. These fears had particular resonance in a South Africa that, from the early 1960s increasingly constructed the external threat to the country in terms of the *rooi gevaar* – the "red peril". Commencing with the Suppression of Communism Act (an almost McCarthy-ite piece of paranoid legislation) in 1950, and subsequent banning and imprisonment of people with communist leanings, the South African government sought – particularly in the wake of the granting of independence to many African countries in the 1960s and their subsequent alliance with the Eastern Bloc – to emphasise South Africa's strategic importance to Western interests. Thus, it is hardly surprising that this general fear of communism also found its way into population policy, as it had in the United States. After its expulsion from the Commonwealth, and becoming a republic in 1961, South Africa looked increasingly to America as its ideological lodestone. Thus, the South African government made much of being among the last West-aligned countries in Africa, and emphasised its strategic importance both in terms of its mineral wealth and its geographical location at the foot of Africa[12]. On some levels, the strategy worked, as can be seen from the policy of "constructive engagement" adopted towards South Africa by the Reagan and Thatcher governments after 1980.

From the mid-1970s onwards, as the dominant orthodoxy of demographic theory was broken down, and replaced not with one but many competing theories, the formulation of population policy in South Africa became increasingly detached from the international mainstream. No doubt this was in part due to South Africa's growing international isolation. However, from then on, the internal conflict over population

[12] The Suez Crisis in 1956, which the South African government used in its propaganda, is one such example. While the canal was blocked, the Cape Sea Route briefly became the main route of transport of oil from the Middle East to Europe and the Americas.

policy in the country became increasingly apparent through the rest of the apartheid era. Van Rensburg's rebuke of calls for higher White fertility, and the President's Council Report, which (despite its internal inconsistencies) appeared to suggest that in order to meet demographic ends, the structure of apartheid South Africa would have to be altered fundamentally, are just two examples.

Thus, the rhetoric on population in South Africa can be seen to have occurred in two distinct phases. The first, lasting from the Second World War through to the mid-1970s saw the application of the international orthodoxy to the South African context, albeit with a spin placed on it to render it superficially compatible with apartheid policies. The second phase, from the mid-1970s through to the demise of apartheid, was characterised by a shift towards formulation of population policy informed by internal political and economic considerations, and – occasionally – a return to neo-Malthusian theory.

The arguments advanced in this chapter concur generally with those made by Youssef Courbage (2001). He also identifies the secrecy and confidentiality attached to demographic research in apartheid South Africa, and posits that apartheid demographers were aware of the political sensitivity of their analyses. Thus, according to him,

> Those Afrikaner demographers who shared the vision of government preferred not to unpack the demographic realities for the general public … the officially sponsored demographic analyses never exposed the real reasons for the population policy. Rather than give the political reasons, containment of the black population and maintenance of White supremacy, Malthusian arguments were advanced: the demographic explosion was far exceeding [South Africa's] economic potential, and was environmentally devastating. (Courbage, 2001:12, translated)

The lengths to which South African demographers went to avoid highlighting the impact of apartheid policies on demographic outcomes suggests that they became increasingly aware that the structure of South African society from the 1950s onwards was not particularly conducive to fertility decline. It thus becomes imperative to examine that structure, and its associated institutions in order to comprehend fully the nature of the South African fertility decline. Understanding South African population policy and the contradictions that it embodied, combined with an analysis of institutions that affect fertility, provides the essential insight into why the South African fertility decline followed its distinctive course.

More importantly though, the lengthening of birth intervals together with the fact that an increase in African women's use of contraception did not result in the fertility decline so desired by the government suggests that over the years from 1965, African women unintentionally undermined government family planning polices. Rather than using contraception for fertility limitation, as the government wanted them to, the provision of modern contraception offered women a very real means of asserting greater control over their lives in a situation where such control was rarely available to them. The nature of institutional effects on the lives and fertility of African women are explored in the next chapter.

6 THE INSTITUTIONAL CONTEXT OF THE SOUTH AFRICAN FERTILITY DECLINE

This chapter applies the framework on the effect of institutions on fertility described in Chapter 2 to the specific case of the decline in fertility in South Africa over the last fifty years. In keeping with the need for an historically-situated analysis, the chapter builds on the material presented in the preceding chapter, which traced the rise and evolution of population policies in South Africa over the course of the 20th century, paying particular attention to the years between 1948 and 1990.

The analysis in the previous chapter of South African population policy from the 1950s shows, as McNicoll (1994) and Greenhalgh (1995b) have argued, the importance of understanding local demographic dynamics in the wider context of international and national planning priorities and institutional change. While such investigations have seldom been undertaken in sub-Saharan Africa, Lesthaeghe and Eelens (1985) have pointed to the need for institutional analysis to expand our understanding of fertility transitions in Africa:

> The restructuring of social organisation and the functional adaptation of institutions are at present unfolding in sub-Saharan Africa, be it of course along different tracks than in Western Europe. In our opinion, those responsible for social analyses and for formulating policies would be well advised to look into these matters more closely and to correct the bias of putting too much trust in the power of national governments and their new bureaucratic agencies for organising the new preventive checks in Africa. (Lesthaeghe and Eelens, 1985:49)

Chapter 5 demonstrated how apartheid population policies represented a shifting syncretism of international thought and (internally-contested) national ideology. This chapter examines the effect on the fertility decline of institutions specific to South Africa under apartheid, and proposes that an institutional analysis of the South African fertility decline provides answers to three important, and related, questions:

- Why has the South African fertility transition taken as long as it has?
- Why did African women demand and adopt modern contraception methods when they did?
- Why have birth intervals increased massively since the 1960s?

This chapter therefore addresses directly the effect of institutions on the pace and nature of the South African fertility decline, and presents an analysis of the effect that key apartheid institutions exerted on African South Africans, and hence on their fertility and childbearing strategies. The first five sections present analyses of the effect of these institutions on fertility in South Africa. The final section (6.6) synthesises this material, contextualised by the discussions in the previous chapter into a coherent explanation of the particularities and peculiarities of the South African fertility decline. In doing so, it is argued that the current trends in South African fertility and childbearing are the path-dependent consequences of the policies, programmes and actions of the apartheid state since 1948.

As argued in Chapter 2, fertility and fertility change are not determined solely at the level of the individual, but are also affected by social formations and institutions. The imperative to investigate the institutional characteristics, and to situate individuals' reproductive behaviour in its institutional context, is possibly even greater in South Africa where, in Bozzoli's phrase, "the forces of structure and agency are so unevenly balanced" (Bozzoli, 1991:2).

No previous attempt has been made to understand the specific effects of apartheid institutions on South African fertility. While rigorous analysis of the South African fertility decline of necessity has to be contextualised with reference to the nature of the apartheid state over the last half century, little attention has been paid to the role played by the state and social institutions in determining the course of the South African fertility decline.

Other researchers have investigated aspects of the relationship between the apartheid polity and population processes in South Africa, although they have tended to force macro-level considerations into the background. For example, Chimere-Dan (1993a) discusses in general terms the fact that apartheid education and the migrant labour system may have contributed to the slow pace of fertility decline. However, his analysis does not identify, specify or investigate the mechanisms whereby this may have occurred. One exception is the work of Carol Kaufman (1996, 1998, 2000), which sets out the social and political context in which African women adopted modern forms of contraception, as well as investigating the community-level effects associated with women's use of contraception through applying multilevel models to the 1987-9 DHS data.

In addition to the list of institutions set out by McNicoll and listed in Chapter 2, others need to be considered to reflect the specificities of the South African situation. The most important of these are the institutional aspects of gender relations precipitated by apartheid. With the history of population policies presented earlier, and taking McNicoll's framework for the analysis of the institutional determinants of fertility as a starting point, it is possible to construct a more detailed picture of the dynamics of the South African fertility transition.

6.1 Institutional endowments

The history of South African economic, social and political development fits none of McNicoll's hypothesised institutional archetypes neatly. While ostensibly claiming to be adhering to a "traditional capitalist" development strategy, the South African state's active intervention in all areas of personal and public life does not square well with the *laissez-faire* attitude assumed to be typical of such strategies. On the contrary, the apartheid state systematically set out to expand state power at the expense of other social institutions. In addition, while the state frequently claimed that it was following a path of capitalist development, several aspects of that strategy had more in common with statist developmental projects. First, the state's policies of racialised development systematically denied access to capital to most South Africans. Second, as O'Meara (1996) has argued, in the years after 1948 the form of capitalism espoused was not directed at corporations, but rather was a variant of state capitalism, aimed particularly at establishing and entrenching Afrikaner business interests to further bolster support for the state. Simultaneously, the size of the civil service was expanded rapidly and a great many parastatal and quasi-statal organisations (such as the state-owned Iron and Steel Corporation) were established or recapitalised by the state.

6.2 State power: regularity and duress

Building on the exposition in Chapter 2, this section examines the role of the state in promoting fertility decline in South Africa in the years after 1948, as an instance of McNicoll's analysis of state-driven fertility decline through regularity or duress.

Application of this framework to the dynamics of the South African fertility decline suggests that one of the most important reasons for the slow decline in the level of South African fertility is that, from the 1950s, the apartheid state lacked both the inclination and the will to regularise its relations with Africans. Indeed, on many dimensions, the state's relationship with Africans during the apartheid era can be described in fairness as being the exact antithesis of regularity. The state engaged in arbitrary and unpredictable denials of basic human rights and freedoms, encouraged the breakdown of alternative social institutions (out of fear of them being used to undermine the state) and compounded insecurity about property and residential rights through its use of forced removals and the Pass Laws. Likewise, policies on education, employment and urban residence were, in terms of their impact on Africans, both unpredictable and arbitrary. Furthermore, the state's internal security apparatus compromised interpersonal relations (and hence the creation and maintenance of social capital) within the African community by fostering distrust, division and suspicion. The maintenance of the migrant labour system, too, did much to undermine the role of the family as a repository of social capital, both within and beyond the household. These facets of state activity, combined with the migrant labour system, thus effectively made long-term planning on the part of individual women and families in relation to reproduction impossible.

The apartheid state was equally ineffective at using duress as a means to achieving its desired fertility outcomes. For all of its repressive tendencies and coercive capacity, its lack of political legitimacy among the African population and a heightened sensitivity to charges of racial genocide reduced the state's capacity to force or coerce individuals into particular forms and patterns of reproductive behaviour. This impotence, it must be noted, stands in stark contrast with the state's ability to reach into almost every other sphere of Africans' lives during the height of the apartheid era. There was no 'one-child' policy as in China, nor the incentivisation of sterilisation (as in India), nor could the state realistically appeal to Africans' patriotism or to the national interest in order to effect a rapid change in fertility.

In terms of its inability to promote regularity or exercise duress, the apartheid state was no different from other states in sub-Saharan Africa. What does set the apartheid state apart from those others is its institutional structure. Whereas other sub-Saharan African states demonstrated tendencies towards "lineage dominance" and prebendalist politics – what Bayart (1992) calls the "politics of the belly" – the South African state exhibited neither of these features to the extent seen elsewhere in the sub-continent, although by some measures, occasionally the apartheid state certainly did exhibit prebendalist and kleptocratic tendencies. Furthermore, the South African state was, and remains, more industrialised, and its state structures more entrenched and less prone to instability than those in other African countries. As a result, although other African states also lacked the ability to enforce or coerce desired patterns of childbearing and fertility, these states never had the potential to reach into the household as the state in apartheid South Africa did. A further difference is that, unlike other African states, the apartheid state actively sought to exclude Africans from White civil society, while simultaneously undermining the building of a strong institutional power base within local African communities.

McNicoll's discussion of regularity and duress in sub-Saharan Africa holds South Africa up as the exception testing the rule by quoting Caldwell's observation that South Africa's family planning programme is the "only sub-Saharan national family planning programme comparable in intensity to those in Asia" (Caldwell (1994:13) in McNicoll (1996:22)). However, both McNicoll and Caldwell miss the fact that while the South African family planning programmes were indeed intense (insofar as they made modern contraception widely and cheaply available to a broad section of the population) and driven by a strong desire to promote African fertility decline, the programmes did not challenge the structural constraints that African women faced as a result of the impositions of apartheid.

From this perspective, it is not surprising that despite their intensity, the population programmes implemented in 1974 and 1984 were incapable of delivering the results desired by the state, and that these programmes were subverted by the local populace.

The review of the literature set out in Chapter 2 set out five paths identified by McNicoll (1996) whereby the state could affect, or gain purchase on, the pace of fertility decline. While aspects of each of these paths can be identified in the assessment of state action in South Africa under apartheid, the direction of their effects was contradictory.

Only through the first path identified by McNicoll, the development, funding and management of population programmes, can the apartheid state be seen to have consciously sought to influence the level of fertility. As Chapter 5 has shown, the state had sought to implement family planning policies from the mid-1960s, but had been held back by its fear of being accused of promoting "racial genocide". The programmes that were implemented have been described, both internally and externally, as "intense" and "vigorous". Both the 1974 National Family Planning and 1984 Population and Development Programmes sought to reduce African fertility through encouraging the use of contraception, and promoting the ideal of smaller family sizes. The second route – the socio-legal and administrative regime maintained by the state – corresponds broadly with his earlier discussion of regularity and duress, described above. As that discussion has shown, state actions in this regard were not conducive to extending its purchase on the pace of fertility decline.

Apartheid policies in other areas were neutral to, or incompatible with, their desire for lower African fertility. Certainly, apartheid policies sought to maintain and entrench inequity and inequality along racial lines, thereby (according to McNicoll's third pathway) obstructing the potential for faster fertility decline. Likewise in terms of the fourth mechanism whereby the state can affect fertility, apartheid policies were incompatible with a conscious attempt to reduce African fertility. The maintenance of a system of migrant labour and controls on urbanisation (*inter alia*), strongly affected the economic wellbeing of Africans. Public expenditure and transfer payments that encouraged lower African fertility were too all intents and purposes non-existent. Regarding White fertility, however, the state's policies were – for a while in the late 1960s – explicitly pro-natalist. The "Baby for Botha" campaign, and Robbertse's call for fiscal incentives for higher White fertility is one side of the state's attempts to gain purchase on the fertility transition through changing the economics of childbearing. These, and the purported threats to symbols of (White) national identity, what Benedict Anderson (1991) famously labelled the "imagined community", were especially potent in government appeals for higher White fertility in the late 1960s and early 1970s.

Hence, according to this rubric, the opinion set out in the preceding chapter that population policy in South Africa was neither aided nor informed by a systematic, consistent or coherent set of government policies is reinforced. However, these were not the only impediments to lower African fertility that arose as a consequence of apartheid policies, as is discussed in the following sections.

6.3 Systems of power and authority

A distinctive characteristic of South Africa is the manner in which many traditional institutions of local organisation and authority were replaced by state bureaucracies. As argued in the previous chapter, apartheid policies after 1960 had sought to undo the 'negative' effects of the detribalisation of Africans, which were seen to occur as a result of exposure to Western ideals and lifestyles. Thus, part of the justification for the settlement of Africans in bantustans was to preserve and maintain 'traditional' African culture. Accordingly, the apartheid state did not wish to entirely "capture" (in Goran Hyden's (1983) phrase) the African population and African social institutions or to establish hegemonic social control over Africans, since the imposition of total bureaucratic control from above would negate the policy of "retribalisation". Thus, the extension of state power and control was far from complete. While the state desired control over the African population (and particularly desired control over African fertility), it was not in its interest to capture African civil society entirely. In any event, any such attempt would most likely have foundered because of the state's illegitimacy in the eyes of the African population.

The result was an uneasy co-existence between different forms of authority at a local level. On the one hand, apartheid bureaucrats and township administrators imposed control on Africans by taking on many of the functions of traditional authority, for example the resolution of land claims, the maintenance of a criminal justice system and the enforcement of policies on urbanisation and employment. On the other, however, the apartheid state kept and maintained a parallel justice system based on African "Customary Law" to deal with 'tribal' matters which sought to ensure the preservation of "traditional" culture.

The split of authority between bureaucrats and 'tribal leaders', coupled with the detribalising influences of urban life, undermined both the family and traditional forms of authority based on patriarchy and gerontocracy, as well as the formation of social capital. From the early 1950s onwards, concern was expressed at the high rate of teenage pregnancy among urban African women and the breakdown in parental authority. Eloff, for example, described the problem thus:

> One of the distinguishing features of the community life of the urban Bantu is the high rate of extramarital births. The available features among the big cities of the Union show that nearly as many children are born outside of marriage as are born within marriage. By far the biggest percentage of these children is born to unmarried mothers.
>
> There are different factors that are responsible for this situation. The most important is probably the lack of control by

> both elders and the community. To what extent the control over young people has weakened can be seen when it is compared with the position in tribal life. In tribal life, with its solid local group and the peer group within which young people played and worked together, it was difficult to initiate a personal relationship, or to do anything without the knowledge of the rest of the group. The group controlled the relationship between young man and girl and it was difficult to go further than the permissible form of sexual intercourse. The offender would be punished by a powerful social condemnation. In the cities, parental discipline has weakened, the peer groups have disappeared and there is no integrated community that can pass strong social censure. (Eloff, 1953a:27-28*)

Detribalisation, and excessive individualism were held responsible for much of this breakdown:

> The native has also not succeeded in disporting himself in such a way that individualism, which is typical of the white culture, does not cause damage to the functioning of the family. Members of the family have a strong tendency towards individualistic actions, but now there is no balance to ensure that their individual behaviour can be co-ordinated for the benefit of the family as a whole. (Eloff, 1953a:37*)

and

> The majority of parents in the cities did not enjoy any education, and they did not grow up in the city. The school, the cinema, the storybook or the cartoon strip and many other factors open up new worlds to the child, and these form ideas and interests which are alien to the parent. There are thus no communal thoughts, insights or universal interest between parent and child. (Eloff, 1953b:17*)

These concerns no doubt helped to encourage and promote the shift in policy towards "retribalisation" and "Bantu education", as well as further bolstering the argument in favour of further restrictions on African urbanisation, and presaged the recommendations of the Tomlinson Commission by a few years.

Thus, the failure of the state to fully capture African social institutions limited its ability to influence demographic behaviour within the family, either through promoting regularity or through the utilisation of coercive measures. The enforced complexity of relationships that Africans held to the land further attenuated this power.

6.4 Migrant labour, the family, and family structure

Many histories of South Africa focus on the alienation of Africans from the land after the1913 Land Act had restricted Africans to 13 percent of the area of South Africa. In fact, as both Beinart (1994) and Keegan (1988) have pointed out, the issues around land were more complex because while ownership may have been restricted, settlement and share-cropping rights often remained unchanged. The implications of this retained articulation[1] certainly limited the ability of the state to affect the family economy, and hence the economics of supply and demand for children.

The family, or the household, is the single most important link between individuals and the state in the analysis of fertility. Along with localised forms of authority, the family acts as a filter between the actions of the state and the behaviour of individuals. As McNicoll argues, "fertility decisions are made within a family setting, subject to intergenerational and intergender power relations, to the exigencies of the family economy, and to local interpretations of often-elastic cultural prescriptions. If you would understand what happens, *cherchez la famille*" (McNicoll, 1996:1).

In South Africa, the concepts of family and household were (and frequently still are) elastic. To define what constitutes a household is probably even more difficult in South Africa than in other sub-Saharan African countries. The migrant labour system, combined with the strict controls on urbanisation, resulted in what have been termed "stretched households", domestic units that are connected across space by kinship and remittances of income (Spiegel, Watson and Wilkinson, 1996). In this formulation, the household is no longer a spatially discrete entity, but one that exists simultaneously in multiple spaces, economies, provinces and urban/rural morphologies.

The rise of "stretched households", O'Meara suggests, was not an unintended consequence of apartheid policies:

> At the core of this central aspect of apartheid – the concern to regulate the flow of black labour – were attempts to control the urbanisation of African women. Women were excluded from the system of influx control until the 1960s. However, as early as the 1930s, the National Party and other bodies used the massive inflow of African women to the cities, and the growing proportion of females among the urban African population, as the principal index of the permanency of urbanisation. The apartheid effort to control and direct the labour supply rested

[1] Indeed, it was important to apartheid planners that urban migrants' links to the homelands remained unbroken to inhibit permanent settlement in White urban areas, and to justify the resettlement and "retribalisation" of African South Africans in the homelands.

> heavily on reducing the numbers of African women in the cities… The development of the 'Native Reserves' was seen as crucial to stemming the flows of black labour to the cities – and particularly of confining African women outside of the urban areas. (O'Meara, 1996:70)

As a result of this stretching of households, spousal separation was common, with men tending to be absent from their homes for long periods of time, leaving women behind to tend the land and raise the children more or less unsupported except for remittances. The extent to which apartheid society disrupted Africans' partnerships bore severe implications for gender relations, as will be discussed in Section 6.5.

The restrictions on the urbanisation of African women, the Pass Laws and forced removals also had a profound effect on sex ratios[2] in both urban and rural areas. Simkins (1983) has calculated estimates of these ratios using the 1950, 1960 and 1970 South Africa census data (Table 6.1).

Table 6.1 Sex ratios for the African South African population, by year and place of residence

Census year	*Metropolitan Areas*		*Towns*		*Rural Areas*		*Homelands*	
1950	166	(16.8)	116	(8.7)	117	(34.9)	72	(39.7)
1960	140	(20.2)	104	(9.1)	112	(32.1)	76	(38.6)
1970	130	(18.2)	131	(8.9)	110	(24.5)	79	(48.4)

Source: Simkins (1983:53-7). Figures in parentheses indicate the proportion of African South Africans (of both sexes) living in each area.

However, if children under the age of 15 are excluded from these ratios (since approximately equal numbers of children of each sex are likely to be found, and hence tend to bias the ratio towards 100), the sex ratio among adults suggests an even more extreme pattern:

Table 6.2 Sex ratios for the African South African population over the age of 15, by year and place of residence

Census year	*Metropolitan Areas*		*Towns*		*Rural Areas*		*Homelands*	
1950	201	(21.5)	129	(9.4)	131	(33.7)	51	(35.3)
1960	149	(23.7)	110	(9.8)	121	(31.3)	56	(35.2)
1970	148	(22.3)	155	(10.3)	116	(23.4)	62	(44.0)

Source: Based on data presented in Simkins (1983:53-7). Figures in parentheses indicate the proportion of African South Africans (of both sexes) aged over 15 living in each area.

The data in Table 6.1 and Table 6.2 show clearly the effects of influx control and other government policies on the spatial distribution of the African South African population between 1950 and 1970. The proportion of the African population living in

[2] The number of men per 100 women.

White rural areas decreased, while that living in the homelands increased. Substantial numbers of women urbanised between 1950 and 1960, since the proportion of Africans in metropoles and towns increased, and the sex ratio declined. Despite the hardening of influx control and the extension of Pass Laws to women after 1960, the proportion of women in metropolitan areas remained approximately constant, suggesting that some women were able to find employment or that sufficient circular migration was taking place to keep the sex ratio approximately constant.

The situation in towns was somewhat different. Urbanisation occurred gradually over the twenty years, but significant numbers of African women were forcibly removed from towns to the homelands after 1960.

One of the enigmas arising from the 1974 fertility study (Lötter and van Tonder, 1976) was the relatively small differential between urban and rural fertility. The study found that the (age-standardised) mean numbers of live births was 3.1 in urban areas, and 3.4 in rural areas. Lötter and van Tonder suggest that the smallness of the differential is attributable to a breakdown in social norms leading to higher adolescent fertility in urban areas (although this is unclear from their data); higher coital frequency in urban areas; and the restricted effects of modernisation on urban African fertility, no doubt a consequence of state maintenance of aspects of traditional authority and policies on urbanisation:

> In short: Where urban dwellers remain oriented towards traditional values and norms which are internalised under tribal conditions, a decline in fertility does not follow automatically or mechanically. (Lötter and van Tonder, 1976:44)

Contrary to this position, Kaufman (1996) is unconvinced that the narrow differential can be attributed to these factors, suggesting rather that the comparatively high levels of urban fertility reflect a breakdown in traditional breastfeeding and postpartum abstinence norms, resulting in higher fecundability.

The evidence presented above suggests a further explanation: that the sheer imbalance of the sex ratios had a depressive effect on rural fertility, while increasing urban fertility. This is in accordance with findings from the Lesotho WFS in 1977, where it was suggested that spousal separation reduced the level of marital fertility by at around 9 percent (Timæus and Graham, 1989).

6.5 Gender relations

The breakdown of traditional authority, its replacement by bureaucratised control, and the effects of apartheid land policies in conjunction with the migrant labour system and the government's anti-urbanisation stance had a particularly profound effect on gender relations. Ethnographic accounts provide a rich seam of data on marital disruption and changing gender relations during the apartheid era. These changes can be charted through oral histories of older women collected in the 1970s, in which a recurrent theme is their frustration with what has been termed their "triple oppression" – along lines of class, race and gender. Central to these frustrations was their anger at being left literally holding the baby, and the fecklessness of men in their demands for higher fertility.

One of the key manifestations of this change is the rise in households headed by women: according to the 1998 DHS, 42 percent of all households surveyed were headed by women, while 51 percent of African women interviewed in that survey lived in a household headed by a woman. Much of the literature on female-headed households adopts an overly simplistic mode of analysis. Many such households arise when women are widowed, abandoned, or divorced and many of them are very poor. It is wrong, however, to view all of them as such, since women may become heads of households as a result of conscious decisions made and initiated by them to achieve their economic and social ends. Van der Vliet (1991), for example, describes how perceptions of, and attitudes towards, modernity and traditionality (and any conflict inherent in this binary) are deeply gendered in a South African context, and how women, especially in urban areas, have tried systematically to claim greater autonomy and freedom for themselves and, in so doing, break out of historical patriarchal and social constraints.

In her doctoral thesis, Muthwa (1995) also commented on this desire by women for greater autonomy at the expense of marital cohabitation. She observed that for many women heading households in Soweto, the perceived advantages of marriage were outweighed by its perceived disadvantages. For her informants, heading a household as a woman, while socially fraught and ambiguous on many levels, afforded women improved qualities of life through increased freedom, independence and potential for financial planning and budgeting, even if their material well-being did not improve. At the same time, while Muthwa found that women became heads of household largely as a result of marital breakdown, in the majority of cases it was the woman who initiated the split. This suggests that becoming a female head is often the consequence of choices, informed by their institutional context, made by the women themselves.

Other sources corroborate Muthwa's and van der Vliet's findings. African women's descriptions of their daily lives in the 1980s describe very clearly their alienation from men:

> 'In fact I am no longer interested in men. I am still tired from my husband. When I look at a man now, I feel dizzy … it is happier without him' – D.D
>
> '[The father of my child] doesn't help me to support the child. Now I don't want him to help me because I have a somebody, a boyfriend who helps me. But I won't marry him.' – S.P
>
> 'I am not prepared to marry again. It creates more problems for me. What if I get another irresponsible husband?' – R.R (Vukani Makhosikazi Collective, 1985:137-8)

The tenuous nature of women's rights to live in urban areas (unemployment was sufficient to be "endorsed out") and the limited employment opportunities available to them (the single biggest form of employment of African women was as domestic servants, who had neither job security nor legal protection from summary dismissal), affected their desire for modern contraceptive methods. Since pregnancy almost certainly meant dismissal, and dismissal raised the possibility of being removed from the city, adoption of contraception to delay childbearing became an economic survival strategy for urban African women, as both Caldwell and Caldwell (1993) and Kaufman (1996) have argued. Rural African women faced similar pressures to delay their childbearing. The substantial gender imbalance in rural areas meant that the homelands were populated largely by the very young, the very old, the infirm and women. The absence of male labour to help with ploughing and other agricultural tasks rendered even subsistence farming difficult. Husbands and partners frequently abandoned their women, with remittances to rural areas often petering out as men established alternative households in urban areas. Childbearing thus became a liability for rural women too, if they were to avoid poverty.

6.6 Conclusion: The institutional effects of apartheid on the South African fertility decline

The institutional characteristics of the South African polity between 1950 and 1990 explain why the South African fertility decline has progressed so slowly. The slow pace of decline in fertility is not simply the product of Bantu education and influx control (as Chimere-Dan has argued), nor is it as anomalous as suggested by the Caldwells (Caldwell and Caldwell, 1993). The Caldwells had contrasted the high level of African fertility with the extent and scope of the 1974 National Family Planning Programme and the 1984 Population and Development Programme (what they deemed to be an "Asian-type" programme, with a "higher density of services than is available anywhere in Asia or indeed anywhere else in the world") and the relatively high level of socio-economic development in the country. They proposed three explanations as to why South African fertility had not fallen further.

Their first explanation is that widespread community and political resistance from Africans undermined the government's family planning programme. This explanation is flawed on several grounds. First, the rapid rates of uptake of modern contraceptive methods by African women in the early 1970s, and the high rates of current use subsequently reported, are incongruent with widespread resistance to the use of family planning. Second, the absence of strong internal resistance to apartheid (no doubt in part a consequence of the extent to which apartheid disrupted African communities and actively hindered the formation of strong community culture and local institutions) makes the possibility of resistance to the family planning programmes implausible. Third, historical evidence suggests that African opposition to family planning from the 1960s onwards was sporadic and muted and that White fears of a generalised resistance to family planning among Africans were, to say the least, overstated. Most frequently, African opposition to family planning was articulated in terms of the racialised discourse on population, rather than on the merits of contraception *per se*. (One of the more trenchant articulations of this was a polemic written for the "African Communist", which referred to family planning in South Africa as being "genocidal" ('Letsema', 1982). It is interesting, too, to note that the language of "racial genocide" adopted by this author has a direct antecedent in the fears first expressed by White politicians in the late 1960s and early 1970s). Significantly, opposition to family planning was found predominantly among men and was not representative of a more general African opposition. This suggests that, along lines similar to those argued by van der Vliet, use of contraception was perceived by men to constitute a further threat against their traditional control over women and women's reproduction. Women favoured the use of the injectable contraceptive (Depo-Provera) – not least because compliance was easy, protection against pregnancy was afforded for long periods at a time and, since it was 'invisible', the method was less likely to arouse male opposition (Kaufman, 1996:46ff).

The second explanation offered by the Caldwells was that fertility control among African South Africans was "pointless", since the social stratification of South African society made social mobility impossible. This explanation does not square with economic histories of South Africa. Both Lipton (1985) and Beinart (1994) discuss the changes that occurred in South African society, and the South African labour market particularly, between 1970 and 1990. They present convincing arguments that social mobility (while difficult and obstructed) was not impossible. Importantly, this period was characterised simultaneously by both political repression and the gradual freeing up of the South African social order, as economic growth systematically undid racist job-reservation policies and the government lost the political will to enforce restrictions on African urbanisation. Hence, it is unlikely that barriers to social mobility can be held responsible for the slow pace of the African fertility decline in South Africa. In any event, the rapid continued increase in birth intervals demonstrated in Chapter 4 gives the lie to this argument. It is clear that African women were using modern forms of contraception to modify the pattern of their childbearing.

Likewise, the Caldwells' third explanation, that there were "profound cultural and social differences" in South Africa, resulting in a "refusal" by Africans to limit their fertility has been falsified by more recent data. The lack of women's opposition to contraceptive use for either birth spacing or fertility limitation is indicated in the results from demographic surveys conducted after 1970.

Rather than being explanations, the Caldwells' observations are indicative of the institutional dynamics that were at work in South Africa over the apartheid era. The limited ability of women to change their own position in society, the precarious nature of urban and rural women's existence, together with fundamental and far-reaching changes in gender relations are thus responsible for the rise in demand for modern forms of contraception identified by the government in the mid-1960s.

However, while African women certainly availed themselves of the contraception provided by the government, the reasons underlying that uptake warrant further analysis. Two distinct motives for contraceptive use have been identified in the demographic literature. The first is parity-specific limitation, that is using contraception to prevent a subsequent birth once a desired parity has been achieved. However, the material presented in Chapters 3 and 4 provides no evidence that African South Africans practised parity-specific fertility limitation. Thus, although government surveys reported that African women were in favour of using contraception for this purpose, practice did not necessarily follow.

The second motive is the use of contraception to increase the interval between births. The possibility that African women were using contraception for this purpose was missed by many commentators of the time (and certainly by the planners behind the population programmes), who failed to draw a distinction between contraceptive use for birth spacing and use for fertility limitation. An article in the South African Medical Journal by van Dongen (1975) is a case in point: he argued that Africans needed to make use of family planning clinics in order to reduce population growth and failed to appreciate that women may have been using contraception for entirely different motives. While there was some evidence that women in Southern Africa may have had different motives for using contraception, government planners and demographers did not pick up on the implications of these findings. Thus, for example, Geraty cited evidence from a survey conducted by the Family Planning Association of (then) Rhodesia that

> birth control was seen as a measure introduced by the Government in order to reduce the Black population… On the other hand, family planning, used in the context of spacing births, was acceptable and meaningful, since the target population was able to associate it with practices that had been prevalent in traditional society… (Geraty, 1975:425)

As has been shown earlier, by the start of the 1970s support for contraceptive use to space births was almost universal among African women in metropolitan areas. Thus, contraception, while widely desired, was viewed – primarily – as a mechanism for spacing children, rather than limiting family size.

However, in the South African context, this simple dichotomy is inadequate. Both currently and historically, during the South African fertility transition, parity-specific fertility limitation was not practised. Equally, the pattern of contraceptive use and fertility among African South Africans is not entirely consistent with the use of contraception for birth spacing. In particular, the increase in birth intervals since the 1970s suggests that women's desire to use contraception was not predicated on the age of her youngest child. Thus, African women's decision to use contraception was contingent neither on her parity (i.e. limitation) nor on the age of her youngest child (i.e. spacing in the conventional sense). This suggests a third pattern of contraceptive use, probably most associated with societies where marital relationships are as severely disrupted by institutional dynamics as in South Africa, hinging on women's desire to delay pregnancy and its associated costs *sine die*, and without consideration for parity or age of other children[3].

The conclusion thus drawn here is at variance with that drawn by Bongaarts (1997) who argued that, over the course of a fertility transition, birth intervals remain "relatively invariant", with contraceptive use substituting for 'traditional' means of spacing births – postpartum abstinence and lactational amenorrhoea. Manifestly, birth intervals in South Africa have not been invariant over the course of the decline, which in turn lends further weight to the argument advanced in earlier chapters that the pattern of childbearing in South Africa is qualitatively different from that elsewhere in the developing world.

This observation forces us to radically reassess the efficacy and success of the population programmes implemented in South Africa. The family planning programmes introduced in 1974 and 1984 helped to make modern contraception methods easily and widely available to African women. They were effective at least insofar as they assisted the rapid uptake of contraception by African women. However, urban African women's demand for contraception predated these programmes. Hence that demand must be seen, in some sense, to have arisen from outside the realm of White discourse on population. Moreover, there is no evidence that these programmes altered the pace of the South African fertility decline. Given that the fundamental reason for the launch of those programmes was to provide a vehicle for the rapid decline of African fertility, the programmes must be said to have failed.

Thus, although adoption of contraception from the 1960s onwards was fairly rapid by African standards, the effect on the overall level of fertility was less than expected because it was used for neither spacing nor limitation, but to avoid becoming pregnant for the present. As increasing numbers of women adopted contraception for this purpose, the effect was to set in motion a chain of increasingly delayed births. It is this process that has led to the slow decline in South African fertility: Bongaarts (1999)

[3] I am grateful to Dr Ian Timæus for pointing out this distinction.

shows mathematically that a decline in fertility will occur if, in every succeeding year, a greater proportion of women delay their birth by a longer time.

The South African fertility decline represents an interesting counterpoint to that seen elsewhere in Africa and the developing world, both for the slow pace of decline and for the length of birth intervals typically found among women. From an institutional perspective, aspects of the decline exhibit similarities with that seen elsewhere in the sub-continent. While the state was relatively strong and did not show the same prebendal tendencies so often associated with states in sub-Saharan Africa, the inability of the South African apartheid state to direct the course of the fertility transition is indicative of its failure to fully capture the African population. This failure, combined with the contradictory and incompatible ambitions of government policy provides a better explanation for the slow pace of the South African fertility decline than simply instrumentalist assessments based on the provision of services, and apartheid restrictions on spatial mobility.

Finally, application of the institutional approach to fertility developed in Chapter 2 further suggests that the pattern of change in African women's birth intervals since 1970 has shown path-dependent characteristics. With the collapse of many apartheid institutions by the mid-1980s (all attempts at influx control were abandoned in 1986), many of the forces impelling women to increase their birth intervals had fallen away by 1990. If the rise in birth intervals had been simply a response to the conditions faced by Africans under apartheid, the changes that have occurred over the last 15 years in the South African polity would have alleviated most of those conditions, thereby causing median birth intervals to reach a new equilibrium. As shown in Chapter 4, this has not happened.

One possible explanation for this continued increase is that the pattern of childbearing precipitated by apartheid has itself become institutionalised, proving to be durable and – in some respects – path-dependent. This is tested against other possible explanations in the next chapter.

7 TRENDS AND DIFFERENTIALS IN BIRTH INTERVALS IN SOUTH AFRICA, 1980 - 1998

The analysis presented in Chapter 4 using a variant of the projected parity progression ratio approach has provided compelling and clear evidence as to the lengthening of birth intervals in South Africa over the last forty years. That approach, however, does not permit the statistical modelling of the trends and differentials in birth interval length among African South Africans. The review of the literature on institutional analyses of fertility change presented in Chapter 2 suggests that the use of statistical techniques should, in McNicoll's (1992) words, "have a properly subordinated part" in expanding our understanding of the process of fertility decline. However, this does not imply that such investigations should not be attempted.

An additional reason exists as to why these investigations should be pursued in the South African context. Investigations into birth intervals elsewhere in the developing world have demonstrated repeatedly the potential for such analyses to shed "major new insights into patterns of reproductive behaviour" (Hobcraft and McDonald, 1984). A consequence of the poor quality and restricted availability of demographic data collected in South Africa (as well as the paucity of demographic skills to analyse those data that were collected) is that no investigations of this kind have been attempted with South African data before. Hence, any statistical analysis of the trends and differentials in birth intervals in South Africa increases our understanding of demographic dynamics in South Africa over the last few decades.

Arising from the material presented in the three preceding chapters, one anomaly stands out that can be investigated using the birth history data in the South African Demographic and Health Surveys. Chapter 4 showed that the lengthening of birth intervals since 1970 continued after the end of apartheid in 1990. However, the analysis presented in the last two chapters argued that the increase in birth intervals in South Africa was a consequence of apartheid structures and institutions, as women sought to delay their childbearing as a survival strategy. These conclusions raise a further question: "Why have birth intervals among African South African women continued to increase after 1990, and what differentials can be identified in women's childbearing behaviours?". This chapter seeks to provide an answer to that question through the investigation of the trends and differentials in African women's birth intervals in South Africa between 1980 and 1998.

The different methodological approaches that have been adopted by other researchers in similar investigations (as well as that adopted here) are evaluated in Section 7.1, while conceptual issues arising from attempts to model birth intervals are discussed in Section 7.2. Section 7.3 describes the process whereby the data from two South African Demographic and Health Surveys were manipulated into a form appropriate to the methodological approach adopted. Section 7.4 discusses in some detail the limitations and pitfalls of the approach adopted. Hypotheses that distinguish between different possible accounts are presented in Section 7.5. The remainder of the chapter is devoted to the parameterisation and fitting of statistical models to the length of women's birth intervals in South Africa, using the data from the 1987-9 and 1998 South African Demographic and Health Surveys.

7.1 Approaches to modelling birth intervals

The measurement of birth intervals offers up substantial challenges to demographers. In the first instance, such analysis requires complex and detailed data sets that only became available for developing countries with the collection of data for the World Fertility Surveys conducted in the 1970s, and subsequent Demographic and Health Surveys. These data (and the increase in computing power available) provided an impetus for demographers and statisticians to develop new methods for analysing and interpreting the determinants of women's birth intervals. At the same time, however, even these more detailed data are of limited usefulness. Women may have given birth many years before the survey, but – while detailed maternity histories are collected – other information (including that on factors likely to affect women's childbearing: contraceptive use, marital status and residence among others) is usually only collected about women's current status.

After attracting substantial interest in the late 1970s and 1980s, the development of analytical techniques for the measurement and analysis of birth intervals reached something of an impasse by the early 1990s. This is unsurprising. First, the decline in fertility worldwide reduced the urgency of developing robust statistical techniques to measure and analyse birth intervals. Second, the methodological difficulties encountered in the modelling of birth intervals led to a growing belief that attempts to do so were unlikely to be successful. Third, data sufficient for the purpose were not usually collected or available. Thus, for example, Rindfuss, Palmore and Bumpass (1989:208) came to the conclusion in their review of published papers analysing birth intervals that "…until such advances [major investment in prospective data collection] are made, attempts to understand differential fertility in terms of the proximate determinants at the individual level may be at a dead end".

Despite this gloomy assessment, a variety of statistical approaches have been used, with greater or lesser success, to test hypotheses relating to differentials in birth intervals. Three broad approaches can be identified in the literature, and are discussed below.

7.1.1 Logistic regression

The first approach that can be used to investigate differentials in birth intervals is logistic regression. The record for each birth is expanded to create a record for each of a number of time segments. A binary variable is then added to each new record marking whether or not a subsequent birth took place in that time segment. This variable is then used as the dependent variable in a logistic regression to model the odds of having a birth in a given time segment. These odds can readily be converted into standard demographic measures, for example probabilities of not having another child in a given time interval. Hence, this approach can be viewed as the fitting of multivariate life tables to survival data. Palloni (1984) and Guilkey and Rindfuss (1987) have both conducted investigations using variants of this approach.

The resulting predicted probabilities of having a birth in a given time segment of length *n* are analogous to the values of ${}_nq_x$ in a life table, where *x* represents the time already elapsed since the preceding birth. The significance of independent variables can be determined from the logistic regression, and multivariate life tables can be derived based on any combination of the covariates specified in the models. Further, a single summary measure, a conditional "expectation of survival" (analogous to the conventional life table measure e_x) can be derived for each life table, with the closing-out of the life table being determined using the approach set out in Guilkey and Rindfuss (1987).

Computationally, models of this form pose few difficulties. However, the method does not cope adequately with cases censored by the interview date. These cases are assumed to contribute to the exposed-to-risk for the entire interval under examination, but are not in fact exposed for the whole duration. The two other methods that have been used in investigations into birth intervals and their determinants deal more effectively with this problem.

7.1.2 Proportional hazards models

The measurement of survival in a given state, and the accommodation of censored data, is one of the foundations of demographic work. Cox's work on proportional hazards models (Cox, 1972) established the statistical framework for the analysis of the covariates and determinants of survival times, and thus allowed the modelling and testing of hypotheses relating to the covariates of survival phenomena. Proportional hazards models offer, at least theoretically, an approach to modelling multivariate correlates of survival data, while better accommodating the need to allow for censoring than the logistic regression approach outlined above. However, the approach has some very specific limitations of its own, which limit its applicability and usefulness.

Cox's regression model is defined in terms of a time-dependent hazard, $\lambda(t)$, and a set of covariates, $\mathbf{z}$ such that

$$\lambda(t; \mathbf{z}) = \exp(\mathbf{z}\boldsymbol{\beta}) \cdot \lambda_0(t), \qquad (1)$$

where the $\boldsymbol{\beta}$ are the coefficients of $\mathbf{z}$ to be estimated, and $\lambda_0(t)$ is an unknown, and unspecified, function giving the hazard when $\mathbf{z} = 0$, the "baseline hazard function".

Implicit in the specification of the proportional hazards model is the assumption that the hazards for the covariates are proportional to the (unknown) baseline hazard function. In other words, the effect of the covariates is assumed to shift the baseline hazard function up or down by a constant proportion. In all applications of Cox's model, however, it is essential to test whether or not the proportionality assumption holds. Failure to ascertain the validity of the proportionality assumption, or to modify the model accordingly (through the use of time-varying covariates), constitutes a severe and serious misuse of the method. As Singer and Willett observe,

> researchers should be especially circumspect about the tenability of the proportional hazards assumption: estimated effects of predictors may be wrong if the adopted model incorrectly constrains the log-hazard profiles to be parallel with identical shapes. Ignoring such underlying failures can lead to incorrect substantive conclusions. (Singer and Willett, 1991:279)

An examination of recent research on birth intervals that use proportional hazards models suggests that many researchers have been less than careful in setting out (or even testing) the proportionality assumptions underlying their models. Few papers that examine the determinants of birth intervals set out the models used. An investigation into the determinants of birth intervals in two Indian states (Singh, Suchindran, Singh *et al.*, 1993), for example, contains no discussion on the validity of the proportionality assumption. Ahn and Shariff (1993), on the other hand, present formulae that suggest that non-proportionality has been accommodated, but this is nowhere discussed.

These failings notwithstanding, proportional hazards approaches to the statistical analysis of birth intervals became increasingly common in the late 1980s and early 1990s. In addition to the papers already mentioned, a sizeable body of literature on birth intervals exists that has used proportional hazards models with greater or lesser success (see, for example, Ofosu (1989) and Trussell, van de Walle and van de Walle (1989)).

Part of the elegance of the proportional hazards model approach stems from the fact that it does not seek to parameterise the underlying failure distribution, since fitting a parameterised functional form to the underlying hazard function is not only difficult, but potentially computationally messy (Trussell, 1984). However, the baseline hazard function in a proportional hazards model can only be estimated indirectly, thereby making interpretation of results from such models somewhat more difficult. Finally, allowing for time-varying covariates is not analytically simple with the proportional hazards framework. This, together with the difficulty of interpreting the results from the models and of validating the proportionality assumption suggests that the disadvantages of using the proportional hazards approach outweigh the benefits.

An alternative is an approach that shares many features of Cox proportional hazards models, but (despite its own limitations) suffers from none of the serious drawbacks outlined above.

7.1.3 Piecewise log-rate models

Piecewise log-rate models, as applied to the analysis of birth intervals by Trussell and Hammerslough (1983) and set out in more general fashion in Yamaguchi (1991), offer a different approach to the models presented above.

The underlying assumption of the approach is that the hazard (or risk of failure) varies between heterogeneous groups, and that the hazard is constant within groups. These models form a subclass of Poisson regression techniques, which are suited to investigation of the rate at which events occur, where the duration of the exposure to risk of an event occurring is of importance.

Such an approach has much to recommend it. First, the approach does not require the rigorous assumptions involved in the use of proportional hazards models. Assumptions of proportionality can be made, but are not essential. Second, the approach allows the presentation and calculation of results in terms familiar to demographers, since the estimated incidence rates arising from the model can, with minor algebraic manipulation, be transformed into probabilities, and thence into familiar life table measures.

A third advantage of using Poisson regression in preference to proportional hazards models is that the method is particularly amenable to adaptation to accommodate data from more than one survey. By aggregating the number of events and the total exposed-to-risk for similar groups of women in different data sets, it is possible to combine these data, and thereby permit the direct statistical comparison of event histories from more than one data source. This modification to the Poisson regression approach can also be applied to methods based on logistic regression, but doing so does not remove the overriding objections to the use of the latter approach. This flexibility is of particular importance for the investigation being undertaken here, where the focus is on secular trends in birth intervals as indicated by the data on women's childbearing collected in two different surveys. The decision to work with aggregated data, of course, involves a number of trade-offs, which are set out explicitly in Section 7.4.

One fundamental difference between Poisson regression and proportional hazards models is the manner in which the incidence or hazard rate is constructed. In the former, the log-incidence rate is assumed to be piece-wise constant (hence the alternative name for this approach, piece-wise log-rate models) across defined segments of the birth interval, whereas the proportional hazard model assumes the hazard to be a continuous function.

The functional form of the piece-wise log-rate model is given by

$$\ln \lambda/D\ (t; \mathbf{z}) = \alpha + \boldsymbol{\beta}_t . \mathbf{T} + \boldsymbol{\beta}_i . \mathbf{z} + \boldsymbol{\beta}_{it} . \mathbf{T}.\mathbf{z} \qquad (1)$$

or, taking the exponential of each side,

$$\lambda/D\ (t; \mathbf{z}) = \exp\ (\alpha + \boldsymbol{\beta}_t . \mathbf{T} + \boldsymbol{\beta}_i . \mathbf{z} + \boldsymbol{\beta}_{it} . \mathbf{T}.\mathbf{z}) \qquad (2)$$

The left-hand side of the equation represents the estimated incidence rate, being the number of events observed (i.e. the number of birth intervals closed in the period of investigation) divided by the aggregated number of person-months exposure in the period of investigation. The subscript **t** refers to the segment of the birth interval being considered.

On the right-hand side of the equation, α is a constant, while the vector $\mathbf{z}$ represents the covariates (including dummy variables in the case of categorical variables) and $\beta(t)$ a vector of the estimated coefficients, a function of the segment of the birth interval under investigation, and **T** is the time variable.

The choice of breakpoints to define the time segments is somewhat arbitrary. As with logistic regression approaches, very narrow time segments (e.g. a few months) permit more accurate modelling of the incidence rate over time since last birth, but also increase the possibility of only a few events being observed in each segment, thereby resulting in possibly inferior estimates of the hazard. By contrast, wider intervals reduce the number of estimated parameters in the model and avoid over-fragmentation of the data, but suffer from the effect of the assumption that the hazard remains constant within each time segment. The implications of this for the models fitted are discussed in Section 7.3.3.

The most important assumption underlying the use of Poisson regression techniques is that the distribution of events (i.e. the number of women closing their birth intervals) follows a Poisson distribution (Frome, 1983; Holford, 1980). This requires that three conditions are met: First, that the number of events in any two non-overlapping intervals of time must be independent; second, that the probability that an event occurs in any very short interval of time must be approximately proportional to the length of that interval; and third, that the probability that two events occur in a very short period of time must be much less than that of just a single event occurring (de Groot, 1986:254-5). In the case of the count data at hand, these conditions are fulfilled. The fact that a birth interval is closed in one time segment has no effect on the probability that another birth interval (obviously not to the same woman) is closed in the next. For the second and third conditions, it stands to reason that the probability that an interval is closed in some time segment t is roughly proportional to the length of the segment and that in any short time segment, the probability of many events occurring is very much less than that of just a few occurrences.

Thus, on substantive grounds, there is a strong case to be made that the number of events follows a Poisson process. Further evidence in this regard is provided by investigations into the distribution of the number of events. According to Dobson (1990:43), the number of events can be assumed to be Poisson-distributed if "the variability [of the count variable] increases as the number of events increases". Greene (1998) uses this simple rule-of-thumb to investigate the validity of the Poisson assumption in her cross-national investigation of the relationship between contraceptive use and children ever borne in sub-Saharan Africa. She notes that log-linear Poisson regression is preferable to linear regression, as the latter requires the assumption that the variance in each cell is constant. In her study she observes that the variance of the number of events in each cell is approximately proportional to the mean number of events in each cell.

Initial investigation of the data used in the investigation of birth intervals in South Africa confirms that the mean and variance, while proportional, are not equal. As a result, the negative-binomial variant of the Poisson regression approach is preferable for use in testing the hypotheses set out in Section 7.5. The use of negative-binomial models accommodates this over-dispersion of the variance, and is hence the method used here, although the change in the estimated parameters arising from the preference of a negative binomial functional form over a Poisson functional form is fairly small.

7.2 Issues in modelling birth intervals

As mentioned, the analysis of secular trends in birth intervals to assess differentials in and determinants of birth intervals poses substantial and significant challenges. In particular, appropriate methods of analysing birth interval data need to take biases introduced through censoring and selection of data into account to produce robust estimates.

7.2.1 Censoring

The first issue requiring attention is the treatment of censored cases – that is, birth intervals that, at the interview date, have not been closed by a subsequent birth. By its very design, the last maternity for all women interviewed in a demographic and health survey is censored at the interview date. If these censored cases were to be excluded, two biases would be introduced. First, estimates of birth intervals would be biased downwards, since the intervals of women who were intending to have additional children but had not yet done so by the interview date would be omitted, thus tending to bias against women with longer intervals. Second, the secular trend in birth intervals would be distorted, since the open intervals thus excluded relate (by definition) to a more recent time-frame than those intervals already closed by a subsequent birth.

Thus, approaches that allow for the duration of women's exposure to risk of closing an interval are preferable to those that do not. Hence, in the selection of an appropriate modelling strategy, a strong consideration must be the ease and ability with which that strategy can accommodate the duration for which a woman has been exposed to risk. From this perspective, then, proportional hazards and piecewise logistic regression models are preferable to logistic regression approaches.

However, even where statistical techniques are used that permit the inclusion of censored cases, the distribution of birth intervals has a very long right tail. In DHS data which record the maternity histories of women aged between 15 and 50, these intervals could take values of up to 420 months (in the case where a woman has a child aged exactly 15, and is surveyed just before her fiftieth birthday having borne no more children). Values close to this maximum are found in both the 1998 and 1987-9 South Africa DHS. In order to avoid errors introduced by the inclusion of extreme values in statistical models, birth history data (censored or otherwise) for women who had not had a subsequent birth within 120 months of their previous birth were excluded from the analysis. Thus, the resultant estimated hazard functions covers only the risk of a subsequent birth between 0 and 119 months since the previous birth. Further, this means that the survival function does not ever approach zero, but rather indicates the proportion of mothers who still have not progressed to a subsequent birth 120 months after their last.

7.2.2 Selection biases

While censoring biases can be avoided through the use of life table methods and statistical models that build on them, selection bias is more difficult to control. Selection bias arises because, in a retrospective survey, not all women will have been equally subject to censoring. For example, a birth interval commencing at age 15 could have occurred anything up to 35 years before the survey, depending on the age of the mother at birth, while an interval commencing at age 49 could, given the survey design, only have been recorded if that birth had occurred in the year before the interview. Clearly, the further back in time that one seeks to investigate, the more acute the problem of selection bias becomes.

The principal effect of selection bias in the analysis of birth intervals is that, unless it is controlled for, the data analysed will be biased towards women with shorter birth intervals or, as Hobcraft and McDonald (1984) put it,

> selectivity refers to the fact that the transition from birth order i to i+1 can only be studied for women who have achieved at least birth order i at the time of the survey and are thus not representative of the whole population since they have been selected for more rapid childbearing. (Hobcraft and McDonald, 1984:9)

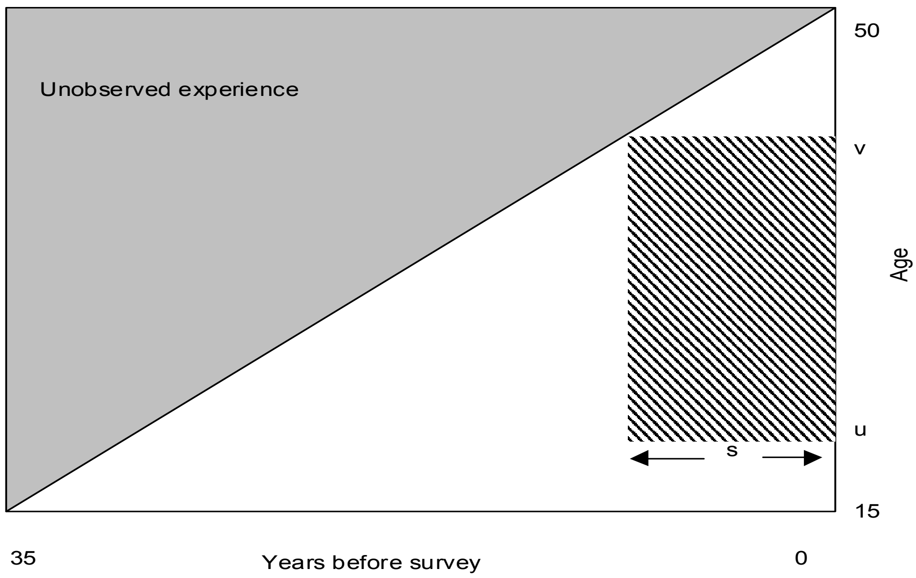
In other words, selection biases are introduced because women with more children will contribute more information on birth intervals than those with fewer children. However, parity is not the only source of selection bias: older women tend to have borne more children (and, on average, more distantly) than younger women, and hence, will contribute disproportionately to data on birth intervals if this is not allowed for.

While there is no single method that compensates entirely for selection bias, the rigorous analysis of birth intervals must ensure that selection biases are minimised. Rindfuss, Palmore and Bumpass (1982) suggest a clear and implementable method of minimising selection bias by investigating only a subset of all intervals available, as indicated by the Lexis diagram in Figure 7.1. The solid-shaded area represents data on women who, on account of their age, were not sampled in the survey, and hence for whom no data exists. Any rectangular slice of data chosen for analysis on a time and age basis that crosses into that dark-shaded area introduces selection bias, since complete data is only available for some women in the time slice.

By contrast, the diagonally-shaded rectangle between ages u and v, and covering a period of s months before the survey date, is a representative sample of birth intervals for women in the survey for whom full maternity histories are available for this subset of ages and period of time. The aim, then, is to define a period of investigation, s, and age-limits u and v such that sufficient data will be present in an event-exposure file, while not giving rise to unacceptable selection biases in respect of fast breeders, although doing so introduces selection bias associated with mother's age at birth. Clearly, however, what is deemed 'acceptable' is a matter of subjective judgement rather than capable of being exactly specified.

One further type of unavoidable selection bias needs to be mentioned here. According to Yamaguchi (1991:136), "defined covariates" (in the terminology of Kalbfleisch and Prentice (1980), those that are fixed in advance for all subjects under investigation) introduce selection bias arising from unobserved heterogeneity because as time passes, the population remaining at risk of the event becomes increasingly select. There is no possible control for this bias, since this bias is not mechanical but a function of the observation of subjects over an extended period of time. Accordingly, results from the models with respect to such covariates need to be interpreted with this in mind.

Figure 7.1 Lexis diagram showing selection for modelling of birth intervals



The approach adopted here in the analysis of birth intervals in South Africa is to examine the maternities of two identically truncated and selected groups of women from two different data sources. The first set of maternity histories is derived from the 1987-9 DHS data, while the second comes from the 1998 South Africa DHS. By combining these data into a single file, the pattern of birth intervals for two identically selected groups of women can be compared directly with each other, and secular changes in birth intervals over the period covered by the two surveys can be identified, thus permitting the testing of the hypotheses set out in Section 7.5. The algorithms used to manipulate the data into the required format, and issues associated with the adoption of this approach are set out in the next section.

7.3 Manipulation of data to investigate trends and differentials in birth intervals in South Africa

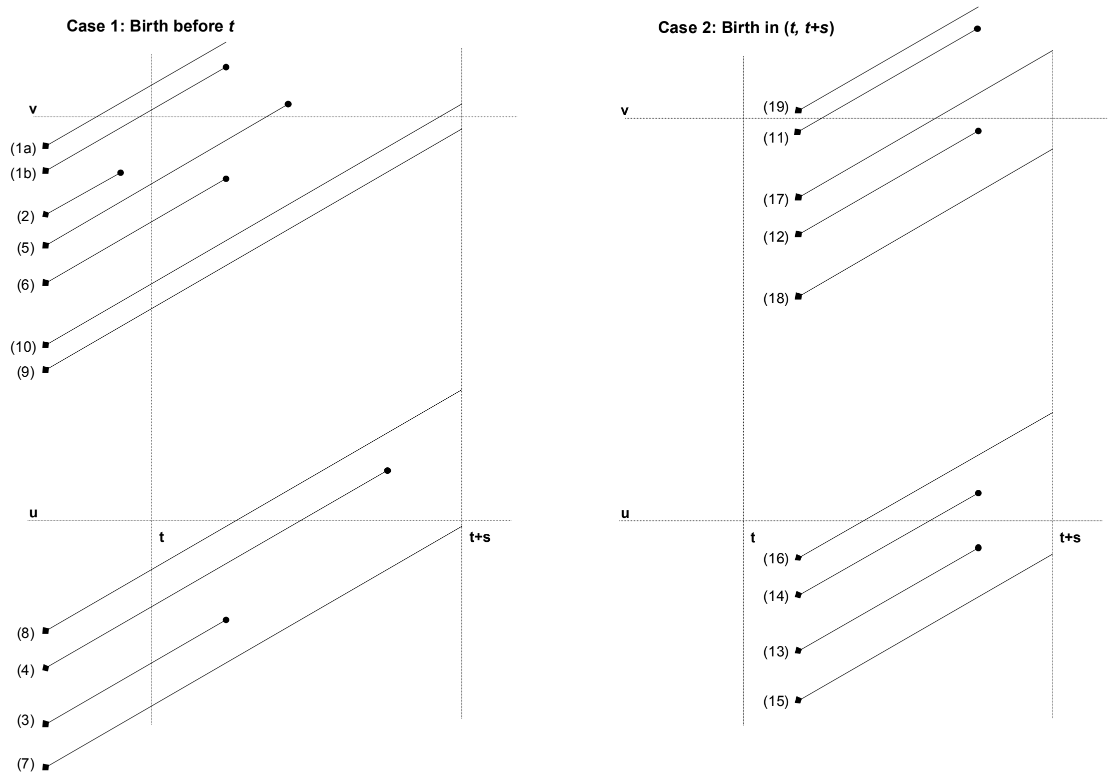
This section sets out the procedures adopted and assumptions made in modelling the trends and differentials in birth intervals in South Africa using data from the 1987-9 and 1998 demographic and health surveys conducted in South Africa. At the outset, it is important to reiterate that the investigations that follow are restricted to the analysis of childbearing and birth intervals among parous women. This constraint arises from the design of the 1987-9 South Africa DHS. Only those women who were married or who had ever borne a child were eligible for inclusion in the survey, thus excluding many childless women. Hence, entry into motherhood cannot be investigated with the two-survey comparative approach adopted here.

7.3.1 Algorithm for calculation of exposure-to-risk

While Rindfuss, Palmore and Bumpass' (1989) approach to minimising selection bias is employed here, a further modification to the criteria for selecting the women (and their births) to be included in the models is necessary. Rindfuss, Palmore and Bumpass suggest analysing only intervals commenced within the time period **s**, the approach adopted here takes into account the exposure in the interval **s** arising from a preceding birth that took place before the commencement of the period of investigation. If left-censoring was not taken into account, the analysis of birth intervals using a Poisson event-exposure approach would be restricted to only those birth intervals begun in the period of observation, and usable information on the time between entry into the period of investigation (**s** months before the interview date) and the subsequent closure of the interval with a subsequent birth, or censoring at the interview date, would be lost. Accommodating left-censored data therefore has two advantages. First, it increases the number of events in the time period under observation, and second, it allows a better estimation of changes in birth intervals over that period. This modification is of particular importance in the analysis of South African birth interval data. The material presented in Chapter 4 has shown that birth intervals in South Africa are extremely long, and hence the restriction of the analysis to only those intervals commenced within the period **s** months before the interview would exclude a great deal of data. The resultant calculation of exposure-to-risk is described below.

Nineteen mutually exclusive possibilities cover the full set of each birth's possible contributions to the event-exposure file. Multiple births at the same confinement are treated as a single maternity, and all subsequent manipulations of the data are restricted to separate maternities. Figure 7.2 shows these nineteen categories graphically, where the index maternity (that under consideration) is represented by a diamond, and a subsequent maternity by a circle.

Figure 7.2 Schematic diagram showing possible contributions to the event-exposure file



Thus, maternity data fitting categories 1, 2, 3, 7, 13, 15 and 19 are excluded from the analysis entirely, as they fail to meet either or both of the age and period requirements. Maternity histories fitting categories 4, 6, 12 and 14 give rise to an "event" in the event-exposure file, and contribute to the exposed-to-risk. The remaining categories contribute to exposure, but not to the total number of events.

Using the definitions in Table 7.1, the contribution of each maternity to exposure within the period of investigation, and the left-censored exposure at entry into the period of investigation shown in Table 7.2 can be calculated.

Table 7.1 Variables required to calculate exposed-to-risk

Variable	*Definition*
x(t)	Age of mother at time t
x(t+s)	Age of mother at time t+s, i.e. at interview
x(i)	Age of mother at birth of child i
x(i+1)	Age of mother at birth of child i+1
u	Minimum age for inclusion
v	Maximum age for inclusion

Table 7.2 Contribution to event-exposure file, by category

Category	*Exposure in period of investigation*	*Exposure at entry into investigation*	*Event*
4	x(i+1) - u	u - x(i)	1
5	v - x(t)	x(t) - x(i)	0
6	x(i+1) - x(t)	x(t) - x(i)	1
8	x(t+s) - u	u - x(i)	0
9	x(t+s) - x(t) [=s]	x(t) - x(i)	0
10	v - x(t)	x(t) - x(i)	0
11	v - x(i)	0	0
12	x(i+1) - x(i)	0	1
14	x(i+1) - u	u - x(i)	1
16	x(t+s) - u	u - x(i)	0
17	v - x(i)	0	0
18	x(t+s) - x(i)	0	0

One particular issue arises with this categorisation of women's contributions to the event-exposure file. While each individual maternity can be represented by one (and only one) of the nineteen categories, different maternities to the same woman may be categorised differently. Thus for example, a woman's first maternity may be of the sixth type listed, while the following two maternities might be of the type described by category 12, followed by a fourth in category 18. Thus, even though the maximum amount of exposure taken into account for any individual woman is s months, this exposure will usually be apportioned across several maternities. Thus, ideally, models of women's birth intervals should take this "clustering" effect (of multiple maternities to the same woman) into account. This matter is discussed in greater detail in Section 7.4.

7.3.2 Creation of historical variables from limited data

The discussion in Section 4.4.1 identified the centrality of contraception and marital status in determining women's birth intervals. Neither contraceptive use nor marital status histories were collected in either of the surveys. However, both questionnaires asked respondents (albeit in slightly different ways) about the dates of their first union or cohabitation, and the date (or parity) of their first use of contraception. From these limited data, it is possible to derive rudimentary binary variables reflecting whether, at the time of birth of a particular child, the woman had ever been married or had ever used modern forms of contraception. In the absence of full historical data, these variables, of necessity, have to be simple: in neither case is the duration of marriage or contraceptive use clear, but they do represent a significant improvement over the use of current-status data to interpret historical dynamics.

Similar considerations arise with the data on women's employment, and their current place of residence. In both of these cases, current-status data are deemed to have been applicable over the entire period for which the woman was exposed to risk. This assumption is clearly problematic, but in the absence of alternative data by which to incorporate women's employment and place of residence, it has to suffice. However, with careful identification of the data to include in the models (and the specification of the length of the period of investigation, s, in particular), the extent of the errors introduced into the models as a result of treating current-status data as historically constant can be attenuated.

Nevertheless, all variables created or used in this way are "defined covariates" in the terminology set out in Section 7.2.2. As such, the use of such variables results in the incorporation of otherwise unobserved heterogeneity in the specified models.

7.3.3 Choice of parameters defining the periods of investigation used

In order to complete the calculation of the exposed-to-risk, values of s, u and v (as defined earlier) have to be fixed. To increase the number of events under observation, while not introducing sizeable selectivity biases, a value of s of 84 months was chosen. This choice is, to all intents and purposes, arbitrary but reflects a trade-off between the value of s (the length of time under observation), and that of v (the "depth" of the investigation, since the choice of s strongly influences the choice of v, the maximum age for inclusion. The most obvious choice is (50-(s/12)) years. In theory, a lower value of v could be chosen, but there is little justification for the data loss that would accompany such a choice. Hence v was set to 43 years.

The choice of the lower age limit for inclusion, u, is also arbitrary. In order to maximise the amount of data under investigation, and to avoid selection effects through the exclusion of younger women. Since high levels of teenage pregnancy have been documented repeatedly since the 1950s (Fuller and Liang, 1999; Preston-Whyte, 1988), it was decided to set this value to the lowest age for which data are available for all women – i.e. 15 years.

Finally, as discussed briefly in Section 7.1.3, the delimitation of the time segments to be used in the models has to be established. Events should be distributed approximately uniformly over the time segment, and not heaped excessively at either the beginning or the end of each segment. Accordingly, the mean duration spent in a particular segment by those mothers closing their birth intervals in that segment should be close to half the length of the time segment.

Taking all these factors into account leads to a choice of time segments of six months length between 18 and 72 months after the last birth. Before 18 months, time segments of length nine months were used, and for intervals still open 72 to 120 months after the birth of the last child, segments of length 12 months were used.

Table 7.3 Mean survival in each time segment of mothers closing their birth intervals in that time segment

Starting point of time segment (months after birth)	*1987-9 DHS*	*1998 DHS*	*Smoothed value*	*a_i factor*
0	7.0	--	7.00	0.78
9	4.9	4.8	4.85	0.54
18	3.2	3.3	3.25	0.54
24	2.9	2.7	2.80	0.47
30	2.8	2.8	2.80	0.47
36	2.8	2.7	2.80	0.47
42	2.8	2.9	2.85	0.48
48	2.8	2.7	2.80	0.47
54	2.9	2.9	2.90	0.48
60	2.7	2.6	2.65	0.44
66	2.7	3.0	2.85	0.48
72	5.5	5.8	5.65	0.47
84	5.1	4.9	5.00	0.42
96	5.3	5.1	5.20	0.43
108	5.2	5.0	5.10	0.43

Table 7.3 shows the mean exposure in each time segment contributed by mothers closing their birth interval in that time segment. As can be seen, these values are generally close to half the length of the segment, and do not differ substantially between the two data sets. The values shown in the table also have a further purpose once the models have been specified. Since Poisson regression models produce results in the form of incidence rates (analogous to central death rates in demographic terminology), the (averaged and smoothed) values shown in Table 7.3 can be thought of as being equivalent to the set of adjustment factors, a_i, required to convert central rates into life table measures of probability (Newell, 1988; Preston, Heuveline and Guillot, 2001).

7.3.4 Creation of a single event-exposure file containing data from two different data sets

The final stage of data manipulation required before the specified models can be fitted is to create a single data file containing aggregated events and exposure-to-risk from the two separate data sources. To do this, equivalent variables (for example, race, urban residence and education) were first created in each of the two data sets, taking care to ensure that the original questions asked in the surveys, and the consequent coding of responses, were compatible.

The algorithms set out in Table 7.2 were then applied to each data set separately, thereby deriving the left-censored starting exposure and exposed-to-risk in the period of investigation for each maternity, as well as an indicator variable showing whether the maternity in question gave rise to an event within the period of investigation.

Data relating to women's seventh or higher order confinements were omitted, partly on account of the sparseness of this data, and because such high orders are sufficiently rare in a South African context for them to be treated as outliers. This results in the exclusion of 4.6 percent of births to African women in the 1998 DHS and 6.4 percent of births to African women interviewed in the 1987-9 survey.

The data files were then collapsed, giving the weighted aggregate exposure and number of events for each combination of the independent variables decided upon, and required to test the hypotheses set out in Section 7.5.

7.4 Conclusion: Review of the methodology adopted, and its limitations

The approach adopted here embodies several trade-offs and consequently has some methodological flaws and limitations that require comment and explanation. The focus of the statistical investigations, and hence the overriding determinant of the methodological approach adopted, is the resolution of the apparent paradox outlined at the start of this chapter. Principally, the investigations undertaken seek to test alternative explanations for the continued increase in the birth intervals of African South Africans after the end of apartheid in the early 1990s. Data from two different surveys, one conducted in the final years of apartheid, the other shortly after the political transition, are available and can be applied to resolve the paradox. The statistical comparison of birth interval data from two different surveys, however, necessitates the combination of these two data sets into a single data file that can then be subjected to statistical investigation. The process of combining the two data sets introduces three distinct sources of error that, while not affecting the estimates of coefficients, exercise an effect on the standard deviations of those estimates.

First, the need to combine data from two different surveys means that important variables relating to the design of each of the surveys cannot be included. In both cases, a stratified, clustered random sample of women was drawn, based on census enumerations. However, due to changes in the demarcation of census enumeration areas between the two surveys, and different sampling strategies in each survey, the aggregated event-exposure file cannot take the spatial stratification and clustering in each survey into account. The survey sample weights, however, were used to ensure that the numbers of events and the amount of exposure in each survey were appropriately weighted to reflect the underlying sampling frames in each survey, which were designed (after weighting) to be nationally representative. Therefore, the estimated confidence intervals calculated for the coefficients will be unquantifiably narrower than they should be, even though the coefficients remain unchanged.

Second, the adoption of an aggregated piece-wise log-rate model precludes allowance for other clustering effects. As suggested in Section 7.3.1, the data on birth intervals in the period of investigation usually reflects several separate maternities, and hence the analysis of the birth interval data should take this clustering into account. Furthermore, with the decomposition of the total birth interval into several discrete time segments, multiple records (up to 15) are created for each maternity contributed by each woman in the two surveys. Thus, ideally, the analysis should take into account the fact that multiple records relate to the same maternity, but also that multiple maternities relate to the same woman. This cannot be done with an aggregated event-exposure file. However, if the data were not aggregated, the clustering effects might be accommodated, but doing so would preclude the correct incorporation of the sample weights for women sampled in each survey.

The third issue is even more intractable than the two outlined above. The design of both surveys (and some of the hypotheses proposed) indicates that multi-level models should be fitted to the data under investigation, since the design effects, and many of the hypothesised variables of significance are not, in truth, attributes of individuals, but rather of communities, or other aggregations of individuals. However, given the difficulties associated with adequately accommodating the clustering and weighting of individual level data from two surveys, attempts to fit more complex multi-level models are not justified.

Furthermore, the answer to the question of whether these methodological failings are significant depends on the perspective that is brought to bear on it. From a purist statistical perspective, the limitations outlined above are indeed severe. However, from a more pragmatic standpoint, several arguments can be advanced as to why, despite these limitations, the methodological approach outlined above may still have value. In the first instance, the imperative to investigate secular trends in birth intervals has necessitated the approach adopted. No other methodological approach could hope to cast light on the trends and differentials in birth intervals among African South Africans without introducing significant and unacceptable selection biases of the forms described in Section 7.2.2. Second, and more importantly, the first two limitations described above exercise an effect on the standard deviation of the coefficient estimates, not on the estimates themselves. Hence the life tables derived as a result of using the methodology outlined in this chapter will not contain biased estimates. Life tables, despite being subject to random error, are not typically published with their standard deviations. In this respect, the output from the models is not much different from that of any other life table technique. Moreover, since the overriding purpose of this investigation is to establish a parsimonious model that describes the data adequately and that permits the derivation of life tables showing the effect of various hypothesised covariates on women's birth intervals, these limitations might be regarded as of minor importance. From this more pragmatic standpoint, then, any marginally significant results arising from the regression models should probably be viewed as being statistically insignificant.

7.5 Hypotheses and operationalisation of independent variables

The combination of institutional analysis with a statistical approach limits the problems associated with attempting to draw inferences and conclusions about national demographic trends in a single country. However, similar to the debates on the efficacy of state-sponsored family planning programmes mentioned in Chapter 2, it is impossible to address the counterfactual of what would have happened to birth intervals in South Africa without apartheid. Nor is it appropriate in this thesis to evaluate the trends and differentials in other African countries for the purpose of comparison. Nevertheless, by further limiting the scope of the investigation to South Africa immediately before and after the transition, it is possible to gain additional insights into the effect of that transition on African women's birth intervals.

McNicoll's point about the limitations of statistical models of demographic outcomes in analyses of fertility from an institutional perspective must be borne in mind. Many, if not most, hypotheses relating to the effect of social institutions on the length of birth intervals that might be of interest cannot be tested using data of the form collected in demographic and health surveys. Thus, for example, while the combination of quantitative and qualitative arguments presented in the preceding chapters makes a strong case for the assertion that African South African women adopted modern forms of contraception in order to postpone their childbearing *sine die*, this cannot be tested using demographic survey data. Only detailed ethnographic and microanalytic research might determine whether the conclusions drawn are correct.

However, other hypotheses about the nature and determinants of women's birth intervals can be tested using demographic survey data. As Greenhalgh (1990) has pointed out, the effects of institutions on individual behaviour vary between individuals (and groups of individuals) in a given society. She argues that the degree to which institutions affect individuals varies by social class and status, since individuals' ability to subvert or modify social institutions is closely associated with their proximity to power within that society. Some indication of the magnitude and direction of these effects can be gained from an examination of the trends and differentials in women's childbearing according to differences in factors already known to affect fertility: marital status, level of education, wealth and urbanisation.

In investigating the continued increase in birth intervals in South Africa after the demise of apartheid, it is necessary to formulate a set of hypotheses capable of distinguishing between different possible accounts as to why this has occurred. Any explanation of this continued increase must have a clearly identifiable causal pathway operating through the proximate determinants of birth intervals discussed in Chapter 4.

The univariate analyses presented in Section 4.4.1 showed that birth intervals of women who had never used contraception before the birth of a child had remained almost constant, while those of women who had, had increased. *A priori*, the increase in birth intervals in South Africa is associated with the uptake of contraception, and its use for delaying childbearing. As an identified causal pathway, contraceptive use is not included in any of the models specified.

Second, birth intervals of married women have increased in line with those of women who had not been married at the time of the birth, and the differential that exists between the birth intervals of married and unmarried women has not widened. Hence it is unlikely that higher rates of marital disruption in recent years (or the path-dependent outcome of changed gender relations precipitated by apartheid, and made manifest by a greater proportion of births to unmarried mothers) are a causal pathway for the continued increase in birth intervals. As a result, a hypothesis is specified to investigate whether trends and differentials in African South Africans' birth intervals according to marital status are significant.

Third, infecundability may have increased, resulting in unintentionally postponed pregnancies. A hypothesis is formulated to examine whether this explanation may indeed hold. Finally, more women may be choosing to terminate unwanted pregnancies. For reasons discussed in Chapter 4, however, this explanation unfortunately cannot be investigated. No data on termination of pregnancy exist in the 1987-9 Demographic and Health Survey, and hence it is impossible to investigate changes in the proportion of women terminating a pregnancy between the two surveys.

Before presenting the hypotheses, however, it is necessary to consider the nature of the main effects in models of the form specified in the preceding sections.

7.5.1 Main and interaction effects of independent variables

In addition to the determination of whether the main effects associated with the hypothesised variables are statistically significant in explaining trends and differentials in birth intervals, several interaction effects are also of interest.

First, the method adopted for modelling women's birth intervals estimates the relative risk of women having a birth, but over a number of time segments. Models that do not include an interaction effect between the hypothesised variable and the time elapsed since the last birth (broken down into discrete segments) make the assumption that the failure rates associated with different values or categories of that independent variable have a constant proportional relationship to each other over all time segments. The hypotheses presented reject this assumption of proportionality explicitly, and hence interaction terms between the variable of interest and the time elapsed since last birth are included. For simplicity of reference in later discussion, interactions of this form are termed "variable-interval interactions".

Similar to this first interaction effect, the second interaction that needs to be accommodated is that between the time elapsed since last birth and the survey data set from which the data come. Again, failure to include interactions of this second kind makes the assumption that the distribution of failure rates over time since last birth are constantly proportional in both data sets. This, then, is equivalent to making the assumption that the shape of the distribution of women's births over the two surveys is identical, one merely being a constant multiple of the other. Given the evidence presented in Chapter 4 of a continued increase in birth intervals over time, this assumption may not hold (i.e. the hazard function may exhibit an entirely different shape). Hence, all models fitted test this assumption by including an interaction between the survey date and the time elapsed since last birth. Interactions of this form are termed "survey-interval interactions".

In testing these interval interaction effects, a continuous form of the duration variable was fitted, rebased to zero at 27 months. By doing so, the additional number of parameters fitted to the models arising from the inclusion of interaction effects is limited[1].

The third interaction effect of interest is that between the hypothesised variable of interest and the survey date. The inclusion of this interaction reflects that the assumption of proportionality of the effects of different values or categories of the hypothesised variable of interest between different surveys may not hold. Interactions of this form are termed "variable-survey interactions", and are assumed, *a priori*, to be significant in the models.

Finally, if all three second-order interactions are found to be significant in the fitted models, the possibility that they all affect each other is tested through the inclusion of a three-way interaction term. Such an interaction reflects the combined interactions of the variable of interest, the intervals under investigation, and secular changes in the pattern of birth spacing over time.

[1] Use of a continuous variable to model the survey-interval interaction has the effect of "tilting" the hazard function with an increased hazard at one duration being compensated for by a decreased hazard at other durations. Investigations using a series of dummy variables to model these interval effects revealed no evidence that the simpler model distorts the pattern of change in birth intervals in South Africa. Therefore, the more parsimonious specification of the interaction effect was adopted for the final models.

7.5.2 Hypotheses

Four investigations into the continued increase in birth intervals can be expressed as testable hypotheses using the data from the two demographic and health surveys conducted in South Africa in 1987-9 and 1998. For the reasons set out in Chapter 4 and Section 7.5, all four hypothesised explanations are assumed to operate through the proximate determinant of contraceptive use.

Hypothesis One: Marital stability and social change

The first hypothesis relates to the effect of marital status on women's childbearing. The evidence presented in Section 4.4.1.2 suggests that marital status is not a strong proximate determinant of birth intervals in South Africa. Hence, marital status can be included in statistical models without undue concern for whether the effect of other variables of interest are in fact operating through women's marital status as a proximate determinant.

Women who had been married at the birth of a child are hypothesised to have shorter birth intervals than women who had never married. Variable-interval interactions are hypothesised to be significant, reflecting the hypothesis that the distribution of women's birth intervals by time elapsed since last birth differs significantly for women of different marital status. Likewise, the variable-survey interaction is hypothesised to be significant, reflecting the hypothesis that changes in South African society, in particular the easing of restrictions on women's cohabitation with their husbands, have changed the pattern of childbearing between the two surveys.

A second investigation related to this hypothesis is that birth interval length is determined by women's propensity to experience marital disruption. The supplementary hypothesis, then, is that single women, and those prone to greater marital instability would have longer birth intervals than women whose lives have been characterised by greater marital stability.

Hypothesis Two: The effect of social status – education, assets and urbanisation

The second hypothesis relates to differentials in the trajectories and patterns of African women's birth intervals in South Africa by their socio-economic status. Urban, educated and (relatively) well-off women are presumed to be among those who survived the ravages of apartheid best, and are hypothesised to have a different pattern of child spacing from rural, less educated and poorer women. In order to maintain their right to urban residence, these women had a strong incentive under apartheid to delay their childbearing as much as possible. They were, no doubt, assisted in this by their greater autonomy and ability to reconstitute marital relations in forms that suited them, resulting in the use of modern contraception to delay childbearing. Further, these women may have acted, and continue to act, as role models for other, less privileged, women.

This hypothesis, then, suggests that the 'typical' factors associated with fertility decline according to modernisation theory will be apparent in South Africa too. Thus, according to this hypothesis, more educated, wealthier, and urban women will have longer birth intervals than less educated, rural and poorer women. In addition, the very factors allowing the former group of women's birth intervals to increase suggests that the differential between the two groups will have widened over the period covered by the two surveys.

Both variable-interval and variable-survey interactions are hypothesised to be significant. The former because it is hypothesised that the more privileged women under apartheid would evince a very different pattern of childbearing from less privileged women, and the latter because of the observed structural changes in South African society over time.

Hypothesis Three: Violence and social instability – spatial differentials in child spacing

The third hypothesis investigates whether the social and political instability in the years surrounding the political transition might have induced women to delay their childbearing. The province of KwaZulu-Natal was particularly affected by violence and social instability, as a low-intensity civil war was waged across the province between supporters of ANC-aligned groups and the apartheid-state-supported Inkatha Freedom Party, which claimed the political and ideological leadership of the Zulus who constitute the vast majority of that province's population. In addition, the civil war in Mozambique, which borders KwaZulu-Natal, might have contributed to the breakdown of social stability in the region. If this violence and the uncertainty that it engendered had an effect on childbearing, it is hypothesised that women living in KwaZulu-Natal would have chosen to delay their childbearing during the years of violence, while women living in less affected provinces would not have done so to the same extent.

Thus, according to this hypothesis, if the increase in birth intervals after the end of apartheid is explained by political conflict, birth intervals in KwaZulu-Natal would have lengthened relative to other provinces, which were (with the exception of parts of Gauteng) relatively unaffected by these conflicts.

Again, a variable-survey interaction term is required to reflect that these forces were in operation largely between the periods covered by the two surveys. The inclusion of a variable-interval interaction term is used to test whether the effect of the conflict changed women's pattern of childbearing in KwaZulu-Natal relative to other provinces.

Hypothesis Four: Disease and sub-fecundability – spatial differentials in child spacing

The fourth hypothesis tests whether the spread of HIV/AIDS in South Africa is responsible for the increase in women's birth intervals throughout the 1980s and 1990s. It is known that women infected with HIV experience greater difficulty in conceiving than women uninfected with the disease (Zaba and Gregson, 1998). A reduction in fecundability might find its expression in increasing birth intervals.

The incidence (and, hence, prevalence) of HIV is not uniform across South African provinces. In 1994 (the earliest year for which antenatal data are available according to the new provincial delimitations), estimates of HIV prevalence ranged from 14.4 percent in KwaZulu-Natal to 1.2 percent in the Western Cape (Table 7.4).

Since 1994, the disease has spread rapidly. Hence, if the spread of HIV/AIDS in South Africa is related to the continued increase in birth intervals in South Africa in the 1980s and 1990s, it is hypothesised that birth intervals would have lengthened most dramatically in those provinces with the highest levels of HIV prevalence in the early 1990s.

Table 7.4 HIV prevalence among attenders of government antenatal clinics in various years, by province

	HIV prevalence (percent) by year			
Province	*1994*	*1996*	*1998*	*2000*
KwaZulu-Natal	14.4	19.9	32.5	36.2
Mpumalanga	12.2	15.8	30.0	29.7
Free State	9.2	17.5	22.8	27.9
Gauteng	6.4	15.5	22.5	29.3
North-West Province	6.7	25.1	21.3	22.9
Northern Province	3.0	7.9	11.5	13.2
Eastern Cape	4.5	8.1	15.9	20.2
Northern Cape	1.8	6.5	9.9	11.1
Western Cape	1.2	3.1	5.2	8.7
National	**7.6**	**14.2**	**22.8**	**24.5**

Variable-survey interactions are hypothesised to be significant, reflecting the low prevalence of HIV infection in the country in the late 1980s and high prevalence in many provinces by the late 1990s. Equally, variable-interval interactions are hypothesised to be significant, reflecting the (possibly unintentional) increase in birth spacing among women living in provinces with higher prevalences of HIV.

7.5.3 Operationalisation of independent variables

This section describes the operationalisation of the independent variables required to test these hypotheses.

7.5.3.1 Marital status

As described in Chapter 4, full marital or relationship histories typically are not collected in Demographic and Health Surveys. Only the date of a woman's first marriage is asked. Hence, it is possible only to know whether a woman had ever been married at the time of a given maternity. This simple binary was used to assess the relative effects of marital status on women's childbearing. (In future, a relatively simple modification to the DHS maternity history questionnaire could provide much more detailed information by asking of each maternity whether the father of that child was known to be the father of the previous child. Doing so would give some information on paternity, and changes in marital relationships over a woman's reproductive lifetime).

In relation to the secondary hypothesis, data on the number of unions are sparse in the 1987-9 DHS, being restricted to a simple categorisation of 0, 1 or more than one unions. However, by combining this information with that on current marital status, a five-fold typology can be derived that gives an indication of women's propensity to experience marital disruption (Table 7.5).

Table 7.5 Typology of marital disruption based on information collected in the 1987-9 and 1998 Demographic and Health Surveys

	Number of unions		
Current marital status	*0*	*1*	*1+*
Single	Category One	--	--
Married	--	Category Two	Category Four
Divorced / Separated / Widowed	--	Category Three	Category Five

The material presented in earlier chapters suggested that women's ability to recast and reconstitute their lives played an important role in shaping the pattern of fertility and childbearing under apartheid. One indicator of that ability would be whether or not the woman was the head of her household, or living in a household headed by another woman. Unfortunately, the data in the 1987-9 DHS are inadequate to establishing an accurate picture of household living arrangements, and hence the sex of the household head cannot be used in these investigations.

7.5.3.2 Social status

Like marital status, information on a woman's social status has to be gleaned from limited data. The second hypothesis in the previous section argues that educated, urban and wealthier women would have significantly different patterns of childbearing in comparison to less-educated, rural and poorer women. Initially, a nine-fold typology of educational status was used, based on the highest grade of education completed and women's level of literacy. This latter factor proved (unsurprisingly) to be highly correlated with highest completed year of schooling. Accordingly, a five-fold typology was used: No education, education up to Grades 5, 7, and 11 (the penultimate year of schooling), and those women who had completed their schooling or attended a tertiary education institution. Urban residence was operationalised according to whether the woman lived in an urban or rural area at the time of the survey. A woman's material status was determined by examining how many of the following items were present in her household: a radio, a television and a refrigerator. In general, ownership of either of the last two items implies that the household has access to electricity. Examination of early models showed little distinction in the childbearing of women with none or one of the items, and little difference between those with two or three. Accordingly, wealth was operationalised as a dichotomous variable, reflecting presence of either one or two items on the one hand, or two or more on the other. It was not possible to use data on income or other assets due to incompatibilities between the two data sources.

7.5.3.3 Effects of social and political instability

The effect of political and social instability was investigated through a simple comparison of women resident in KwaZulu-Natal at the time of the surveys with those who were resident in other provinces. The 1987-9 DHS, however had a different set of provincial delimitations compared to the 1998 DHS, reflecting the fact that the earlier survey was conducted in the four provinces of "White" South Africa, and the ten independent and semi-autonomous "homelands". The delimitation of magisterial districts across South Africa, however, did not change with the political transition, and a variable was captured in the 1987-9 DHS indicating in which of the more than 300 magisterial districts in the country (including the homelands) the respondent was surveyed. Then, using a list of magisterial districts according to the new provincial delimitations distributed with the 1996 South Africa Census, the magisterial districts coded in the 1987-9 DHS were mapped onto the new provincial delimitations.

As a result of this procedure, identical provincial definitions to those in the 1998 DHS were created in the 1987-9 DHS. From this, it is a simple matter to create a binary variable denoting whether the respondent was a resident of KwaZulu-Natal (according to post-1994 provincial delimitations).

7.5.3.4 Effects of the spread of HIV/AIDS on fertility

The same algorithm as that described in the preceding section was used to create a binary variable indicating whether the respondent was resident in provinces with high levels of HIV or not. The choice of which provinces to include in the "high HIV provinces" is, of course, somewhat more arbitrary. An examination of the results from the antenatal surveys conducted between 1994 and 1998 (some of which are presented in Table 7.4) suggests that, despite some variability in estimates in the same province from year to year, five of the nine provinces can be viewed as having noticeably higher prevalences of HIV than the others in the early to mid-1990s: KwaZulu-Natal, Mpumalanga, Free State, Gauteng and North-West province. Accordingly, women resident in these five provinces were regarded as living in provinces with high levels of HIV.

7.5.4 Other variables used as controls

In addition to the independent variables above, several other variables were included in the models as control variables. The choice of these controls was determined from prior information, and findings from other demographic research into fertility and childbearing in South Africa. These variables, and their operationalisation, are described in the following sections.

7.5.4.1 Age of mother

A woman's age has an important effect on fertility outcomes. Older women tend to have borne more children than younger women. Furthermore, the mode of the fertility distribution, as shown in Chapter 3, lies between the ages of 25 and 30, and as women age they are less likely to close an open birth interval with another birth. To accommodate these differences, the grouped age of the mother at the mid-point of the period of investigation (i.e. 3.5 years before the interview date, and grouped into five-year bands) was included in each model.

7.5.4.2 Mother's childhood place of residence

Kaufman (1996) has shown that place of residence until the age of 12 is an important determinant of African South African women's fertility and contraceptive use in the late 1980s. Data were collected in both DHS surveys indicating whether the woman had spent most of her childhood in a rural area, a town, or a major city.

7.5.4.3 Linguistic group of mother's home language

Research done on differentials in fertility in South Africa using the 1993 LSDS (described in Chapter 2), showed that women in Nguni-speaking households tended to bear more children than women in Sotho-speaking households (Moultrie and Timæus, 2001). This difference leads to the *a priori* assumption that there might be important and significant differences in patterns of child spacing by the mother's linguistic group.

7.5.4.4 Birth order

The earlier discussion on selectivity indicates that the number of children borne by a woman has an important effect on her birth intervals. Women with many children, particularly, are more likely to have shorter birth intervals than those with fewer children, even after controlling for other variables.

7.6 Fitted models and results

Together with the key variables required for negative binomial regression models (the number of events, and the amount of exposure), the variables described in the previous section were used to fit models to African women's birth intervals in South Africa over the period of investigation described in Section 7.3, using the methodology described earlier.

The modelling process went through a number of stages. First, a "base" model, which excluded those independent variables (or derivations of them) required to test the hypotheses, was fitted to the data. Having found the best (i.e. most parsimonious) model using only the control variables and having identified necessary variable-interval and variable-survey interactions, this model was then held constant and variables required to test the four hypotheses were added to it.

After the most parsimonious model was identified in each instance, predicted incidence rates (per person-month of exposure) for each element in the data were calculated. These were derived by dividing the predicted number of events estimated from the model by the amount of exposure for each time segment and each combination of the covariates of interest (the survey date and the independent variable operationalised to test the hypothesis). Multiplying these point estimates by the width of the time segment (e.g. nine months for the first two segments), produces point-estimates of the central failure rates in each time segment. Transformation of these rates into probabilities was performed by using the averaged and smoothed values of the data in the last column of Table 7.3 as approximations to a set of a_i factors by means of the formula

$q_x = m_x / [1 + (1 - a_x)m_x]$.

Cumulative survival functions, with a radix of one, were then calculated from these failure probabilities using standard demographic techniques.

In addition to plots of the incidence rates and cumulative survival functions, a summary survival statistic suggested by Guilkey and Rindfuss (1987) is also presented. Even with a cut-off of 120 months, not all women will close their birth intervals. Hence, an exact equivalent to the life table measure e_0 cannot be calculated. Furthermore, at the extreme ends of the life table, modelled estimates of the incidence rate tend to become unstable as a result of small numbers of events, and lower amounts of exposure. Instead, Guilkey and Rindfuss (1987:282) suggest that a “conditional expectation of survival” offers an appropriate manner of “closing” the derived life tables. This approach avoids the need for the imposition of “arbitrary assumptions on those who survive beyond the age where the multivariate life table ends”. Thus, using conventional life table algebra, they derive a summary measure, g^s_0, which indicates the expected time to the event for those who experience the event prior to the end of the last segment *(s+1)*, where *s* is the last time segment for which incidence rates are calculated,

$$g_0^s = \frac{\left[\sum_0^s L_x\right] - [l_{s+1}] \times (s+1)}{l_0 - l_{s+1}} \qquad (1)$$

With the data used in this investigation, the last defined time segment is that from 108 to 120 months. Accordingly, probabilities of survival from 108 to 120 months can be derived (i.e. ${}_{12}q_{108}$), and the final value of the life table calculated will be that of l_{120}. Consequently, in this investigation, Guilkey and Rindfuss’ formula takes the form

$$g_0^{108} = \frac{\left[\sum_0^{108} L_x\right] - [l_{120}] \times 120}{1 - l_{120}} \qquad (2)$$

The large number of parameters in each of the fitted models makes presentation of the model results difficult. In addition, given the large number of control variables and the number of time segments in the models, it is also difficult to assimilate the overall effect of a particular variable through an examination of the estimated coefficients. Hence, the results presented here will focus on the predicted incidence rates, cumulative survival functions, and conditional expected birth interval lengths for the key variables in each model. Full results from the models fitted are provided in the Appendix to the thesis.

7.6.1 The "base" model

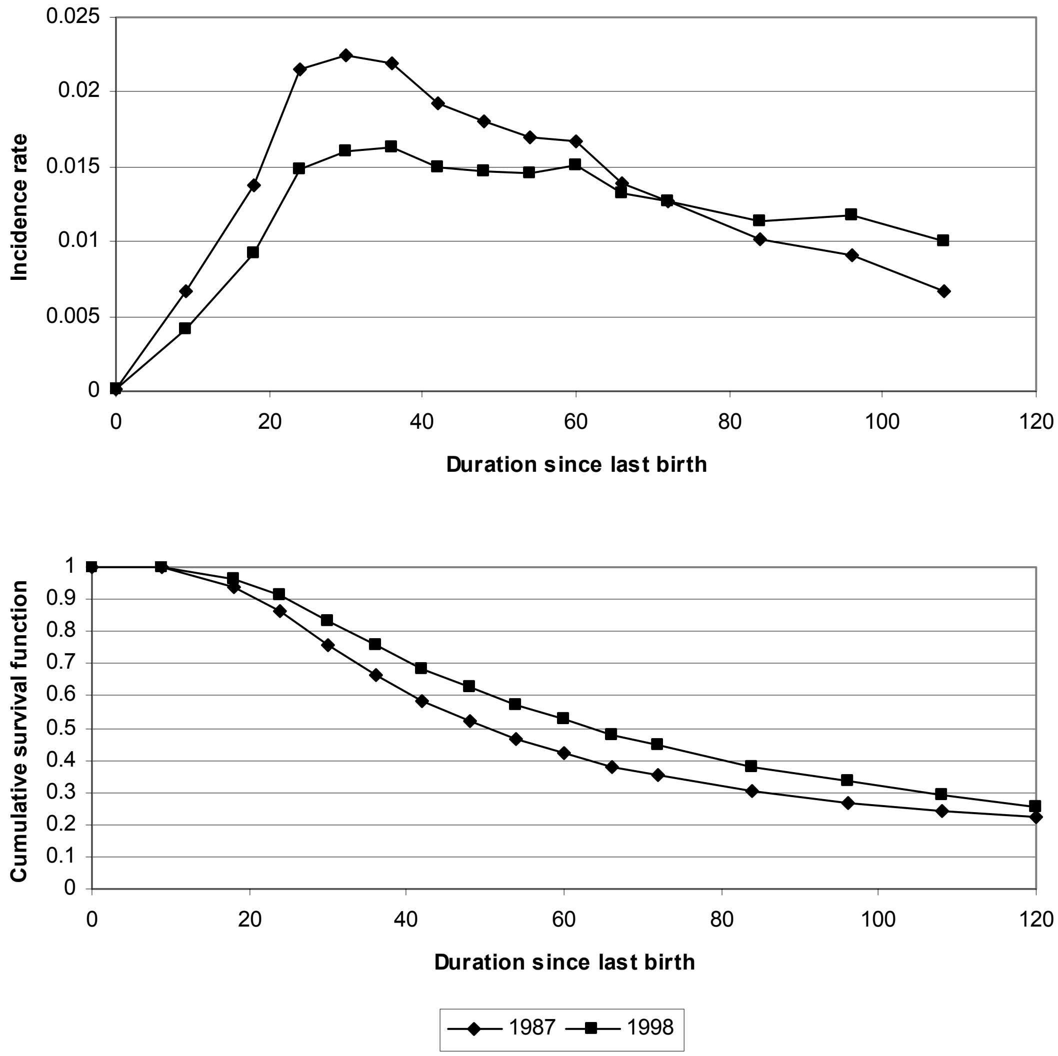
The "base" model of the determinants of women's birth intervals was derived by ascertaining the effect of adding each variable sequentially into the model, and including it if a likelihood ratio test comparing that model to the nested model excluding that variable was statistically significant. Variables whose estimated coefficients were not significant were omitted and the model was then refitted.

Interactions between these main effect variables and duration since last birth were tested, and included where appropriate. The base model allowed for survey-interval interaction as well as variable-interval interactions between the mother's age and her linguistic family. A three-way interaction was required between mothers' childhood place of residence, the secular time in which the survey took place and duration since last birth. After including all these variables and interaction effects, birth order was found to be not significant. Nevertheless, birth order was found to be significant in later models, and was thus retained in the base model. Interactions between birth order and interval were not significant.

The fitted incidence rates and cumulative survival function by duration since last birth and year in which the data were collected are shown in Figure 7.3.

Two important features of the continued change in birth intervals can be identified in these graphs. Looking at the first graph, it is apparent that there has been a remarkable shift in the pattern of women's childbearing between the 1987-9 and 1998 demographic and health surveys. Women in the 1987-9 survey indicated a fairly predictable pattern of childbearing, with a mode around 30 months, and a very long tail giving rise to long median birth intervals. By contrast, the pattern of childbearing by duration since last birth among women in the 1998 survey shows a far more uniform distribution, with incidence rates remaining almost constant between 36 and 72 months, and even then only falling gradually. The effect of this shift is clearly visible in the calculated cumulative survival functions, with women in the later survey progressing more slowly to a subsequent birth, particularly between 36 and 84 months.

Figure 7.3 Fitted incidence rates and cumulative survival functions by year of survey, base model



Most interestingly of all, however, is the indication that the overall proportion of women progressing to another birth within 120 months of the previous birth changed only very slightly between the two surveys, while the distribution of childbearing within that time period has changed dramatically. According to this synthetic measure, approximately a quarter of women will not have another child within 10 years of their last. Hence, parity progression has remained largely unchanged.

A further measure of this change can be gained from the conditional expected birth interval length of women having a subsequent birth within ten years of their last (Table 7.6).

Table 7.6 Conditional expected birth interval length (months) of women having a subsequent birth within 120 months, by survey date: base model

Survey	*Conditional Expectation*
1987-9	46.2
1998	53.3

This table shows that among those women who did close their birth interval within 120 months, women interviewed in the 1987-9 survey did so, on average, just under four years after their previous birth. Between the two surveys, this conditional expectation has increased by more than 15 percent, or 7.1 months.

7.6.2 Results: Hypothesis One – Marital status

This hypothesis tests whether differentials in child spacing by marital status have changed over the course of the two DHS surveys.

After fitting the base model, and variables included in the other hypotheses (province of residence, urban or rural residence, education, and the measure of material well being), clear differences in women's childbearing according to their marital status remain apparent. The main effect of marital status is highly significant, as are both variable-survey and variable-interval interactions. The possible three way interaction of survey, variable and interval was not significant.

Two particularly striking features are apparent from the estimated incidence rates and survival functions (Figure 7.4). First, women interviewed in the 1998 survey who were not married at the time of their birth have a very different pattern of childbearing from married women in either survey, as well as a pattern of childbearing very different from that of unmarried women in the earlier survey. For these unmarried women in the later survey, the incidence of childbearing is more or less constant between 30 and 96 months, while amongst the other three groups, the mode is close to 36 months.

Second, while there are differences by marital status in the proportion of women still to progress to a subsequent birth 120 months after the previous birth in the 1987-9 data, these differences are much smaller in the 1998 data. However, the shape of the hazard function differs markedly by marital status in both surveys. This is further confirmed by the changes in the conditional expected birth interval length between the two surveys (Table 7.7).

Figure 7.4 Fitted incidence rates and cumulative survival functions by survey date and marital status

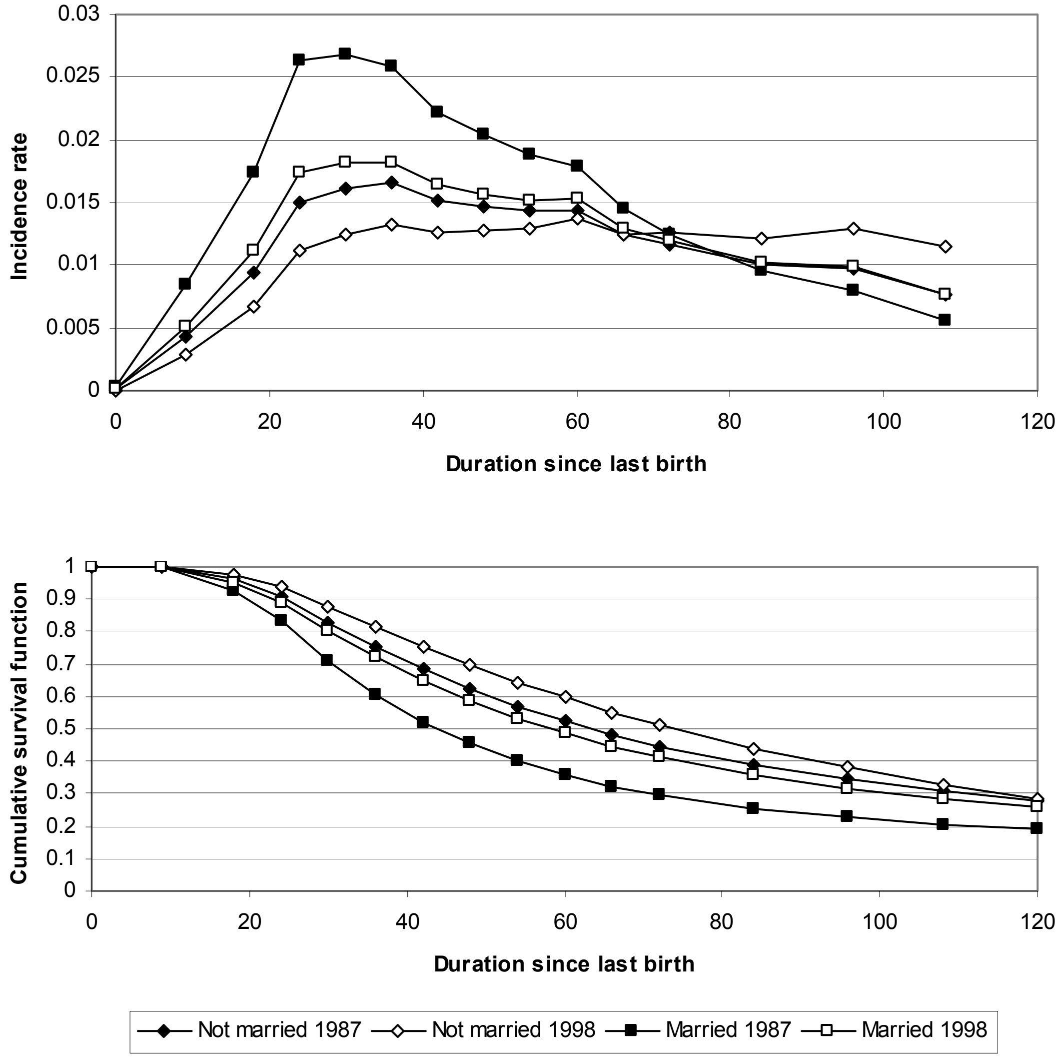


Table 7.7 Conditional expected birth interval length (months) of women having a subsequent birth within 120 months, by survey date and marital status

	Survey	
Marital status	*1987-9*	*1998*
Never married	51.8	58.2
Married	42.6	49.8

There is almost no difference in the change in expected birth interval length between the two groups of women, or over the two time periods covered by the surveys. The conditional interval length for married women increased by 7.2 months, while that for unmarried women increased by 6.4 months. Thus, the hypothesised effects of marital status on women's birth intervals are supported to a degree, although there is some evidence that the differential has narrowed recently. The main effect operates in the direction assumed initially, while the significance of the variable-interval interaction confirms the different pattern of childbearing since last birth for the two groups of women, while the significant variable-survey interaction indicates that the pattern of childbearing has changed over the periods covered by the two surveys.

The second investigation suggested by the hypotheses is that women who are more prone to marital disruption have longer birth intervals than women whose lives are characterised by a greater degree of marital stability. Relative to women who are currently in their first marriage, the estimated hazard is lower for all the other groups of women set out in Table 7.5. In addition, although the data are too complex to permit graphical exposition, there is a wide variation in the proportion of women who have yet to have another child within 120 months of their last (Table 7.8).

Table 7.8 Estimated cumulative survival functions, by propensity for marital disruption and survey

	(1)		*(2)*		*(3)*		*(4)*		*(5)*	
Duration	*1987*	*1998*	*1987*	*1998*	*1987*	*1998*	*1987*	*1998*	*1987*	*1998*
0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
9	99.9	99.9	99.8	99.9	99.8	99.9	99.8	99.9	99.8	99.9
18	96.6	97.6	92.5	95.3	94.2	96.4	94.2	96.1	93.0	95.7
24	92.1	94.3	83.3	89.0	87.2	91.5	86.7	90.7	84.9	90.2
30	85.4	89.0	71.0	79.9	77.7	84.6	76.3	82.8	74.3	82.3
36	78.9	83.5	60.4	71.3	69.1	78.0	66.8	75.0	64.8	75.0
42	72.8	78.1	51.4	63.4	61.8	71.8	58.5	67.5	56.9	68.7
48	67.7	73.4	44.7	57.0	56.1	66.8	52.1	61.2	51.0	63.6
54	63.2	69.1	39.2	51.4	51.3	62.3	46.7	55.7	46.2	59.1
60	59.1	64.9	34.6	46.3	47.3	58.3	42.0	50.6	42.2	55.2
66	55.4	60.8	30.7	41.7	43.8	54.6	37.9	45.8	38.8	51.8
72	52.4	57.3	27.7	38.0	41.1	51.6	34.7	42.0	36.3	49.0
84	47.3	51.2	23.1	31.8	36.8	46.4	29.7	35.3	32.4	44.2
96	43.6	46.1	19.9	27.0	33.9	42.4	26.0	30.1	29.7	40.6
108	40.4	41.3	17.5	22.9	31.6	38.6	22.9	25.6	27.6	37.3
120	38.2	37.5	15.8	19.8	30.2	35.6	20.8	22.4	26.3	35.0

Note: (1): Single; (2) Married, 1 union; (3) Divorced, separated or widowed, 1 union; (4) Married, 1+ unions; (5) Divorced, separated or widowed, 1+ unions.

Thus, as expected, more single women tend to not have another child within 10 years than other groups of women, while women in their first marriage show the greatest likelihood of having another child. Women currently in a second or higher order marriage have the next highest risk, while the risk among divorcees and widowers tends to be closer to that among single women, especially in the 1998 survey. In general, then, the hypothesis is supported. The resulting conditional expected birth interval lengths are given in Table 7.9.

Table 7.9 Conditional expected birth interval length (months) of women having a subsequent birth within 120 months, by survey date and propensity for marital disruption

Propensity for disruption	*1987*	*1998*	*Change*
Single - 0 Unions	51.8	58.3	6.6
Married - 1 Union	43.8	51.2	7.4
Divorced, separated, widowed - 1 Union	45.3	52.7	7.4
Married - 1+ Unions	47.1	53.4	6.3
Divorced, separated, widowed - 1+ Unions	43.4	49.9	6.5

Thus, even though the proportions of women who are likely to have a subsequent child within 120 months may vary by their propensity for marital disruption, the expected timing of births among those women who do have another child is remarkably similar for all women other than those who have never been married.

7.6.3 Results: Hypothesis Two – Education, urbanisation and material well-being

The second hypothesis investigates trends and differentials in women's birth intervals according to their social and economic status. Three variables were included in the model to assess the effect of social and economic status: highest completed level of education, urban or rural residence, and a proxy measure of household wealth based on a scale of consumer durables present in the household as discussed in Section 7.5.3.2.

7.6.3.1 Effect of education

As expected, women's childbearing is greatly affected by her highest completed standard of education. Likelihood ratio tests indicated that the variable-survey interaction did not add significantly to the fit of the model.

Having some education (up Standard 3 – five years of schooling) has no significant effect on the hazard of having another birth relative to having had no schooling at all. The proportion of women closing their birth intervals by 120 months falls with increasing levels of education after this point, with around one in three women who have completed their schooling not having closed their birth intervals within 120 months, compared with one in five women with less than a Standard 3 education (Table 7.10).

Table 7.10 Estimated cumulative survival functions, by highest completed level of education and survey

	None		St 3		St 5		St 9		Matric +	
Duration	1987	1998	1987	1998	1987	1998	1987	1998	1987	1998
0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
9	99.7	99.8	99.8	99.8	99.8	99.9	99.9	99.9	99.9	100.0
18	91.9	93.8	92.7	94.8	93.6	95.7	95.0	96.9	96.6	98.2
24	82.4	85.9	83.8	87.8	85.7	89.8	88.6	92.4	92.0	95.4
30	70.3	75.1	72.1	78.0	74.9	81.4	79.5	85.5	85.2	91.0
36	59.9	65.5	61.9	68.8	65.3	73.3	71.0	78.6	78.5	86.2
42	51.4	57.3	53.4	60.7	57.0	65.9	63.4	72.0	72.2	81.3
48	45.1	51.0	47.0	54.2	50.7	59.6	57.3	66.3	66.9	76.8
54	40.1	45.8	41.7	48.7	45.4	54.1	52.0	61.2	62.0	72.4
60	36.0	41.2	37.4	44.0	40.9	49.3	47.5	56.4	57.5	68.1
66	32.5	37.1	33.7	39.7	37.0	44.9	43.4	51.8	53.2	63.7
72	29.9	34.1	30.9	36.5	34.0	41.4	40.2	48.0	49.7	59.9
84	25.9	29.1	26.5	31.2	29.2	35.7	35.0	41.2	44.0	53.1
96	23.3	25.6	23.5	27.2	25.7	31.3	31.2	35.8	39.4	47.3
108	21.3	22.9	21.1	23.9	23.0	27.3	27.9	30.8	35.5	41.6
120	20.0	21.0	19.5	21.6	21.2	24.4	25.7	27.1	32.8	37.0

Importantly, too, the differentials in women's childbearing by their educational attainment are widening, as shown by Table 7.11. More educated women in the 1987 survey not only had longer intervals in comparison with less educated women, but conditional expected birth intervals for women who had completed their schooling increased by more than double the amount of the increase among women with no education.

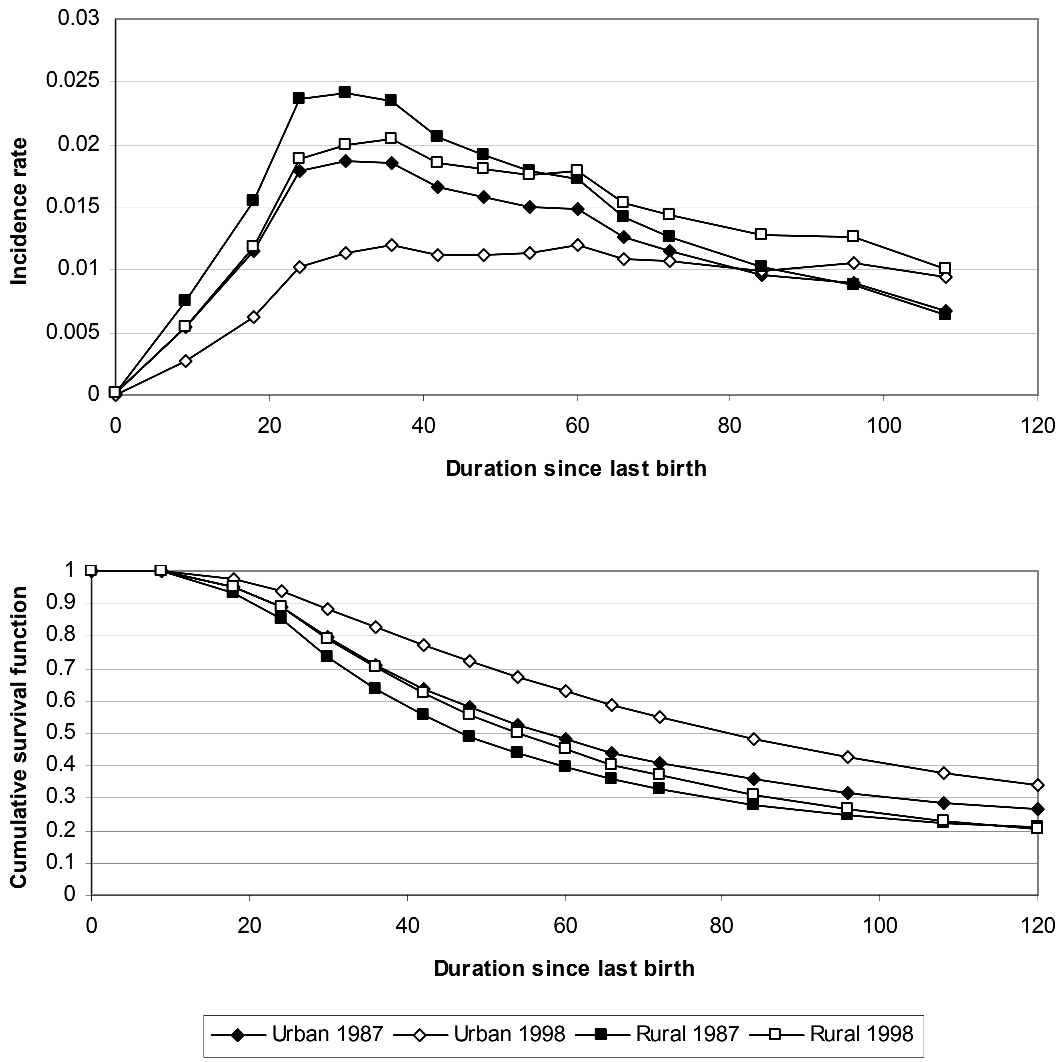
Table 7.11 Conditional expected birth interval length (months) of women having a subsequent birth within 120 months, by survey date and highest completed level of education

Highest completed school standard	1987	1998	Change
None	42.1	46.0	3.9
St 3	43.7	48.4	4.6
St 5	45.7	51.3	5.6
St 9	48.8	55.9	7.1
Matric +	53.5	61.9	8.4

7.6.3.2 Urbanisation

Section 4.4.3 indicated that the differential in women's birth intervals – while increasing for women in both rural and urban areas – is widening. The modelling of these differentials confirms that result (Figure 7.5). The hazard function for urban women in the 1998 survey is almost constant after 36 months, while the other three hazard functions exhibit more typical shapes. There has been little change between the two surveys in the proportion of rural women not progressing to a subsequent birth within 120 months. Urban women are slightly less likely to have another child within 120 months than their rural counterparts.

Figure 7.5 Fitted incidence rates and cumulative survival functions by survey date and place of residence



The effect of the changes in trends and differentials in women's childbearing according to their place of residence can be seen clearly in Table 7.12. While the conditional expected birth interval length for the synthetic cohort of women resident in rural areas increased by 5.2 months over the period covered by the surveys, that for high status women increased by 9.5 months. Thus, while the differential between urban and rural women in the 1987-9 survey was 4.1 months in 1987-9, this had widened to 8.4 months by the time of the 1998 survey.

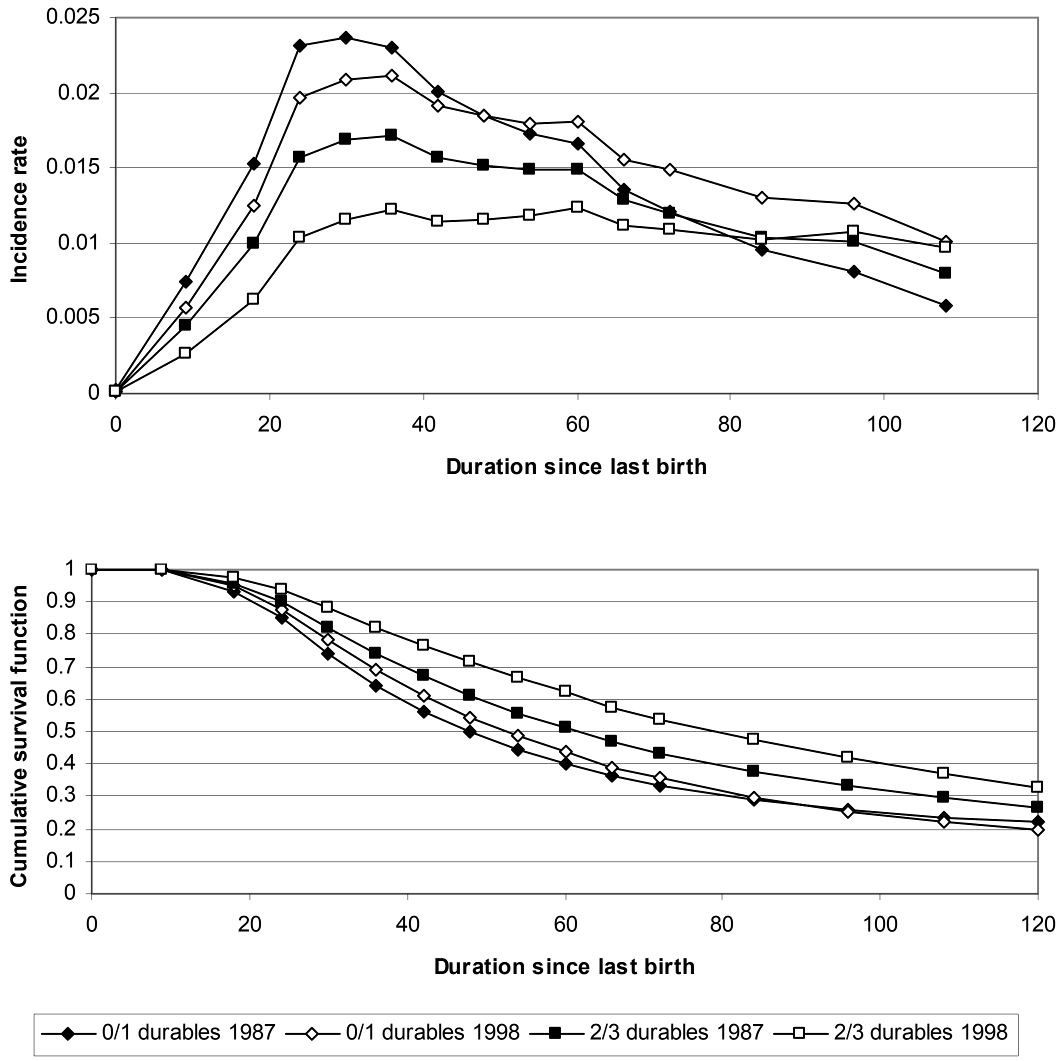
Table 7.12 Conditional expected birth interval length (months) of women having a subsequent birth within 120 months, by survey date and place of residence

	Survey	
Residence	*1987-9*	*1998*
Urban	48.8	58.3
Rural	44.7	49.9

7.6.3.3 Consumer durables in the household

The third aspect of socio-economic status investigated is the extent to which there are significant differentials, and trends in those differentials, among women's childbearing by a proxy for their wealth. As with the investigation in respect of education, the variable-interval interaction was significant.

Figure 7.6 Fitted incidence rates and cumulative survival functions by survey date and number of consumer durables in the household



Women living in households with more consumer durables are less likely to close their birth intervals within 120 months than women living in poorer households. At the same time, the proportion of women in poorer households not progressing to a subsequent birth within 120 months has remained almost unchanged over the period covered by the two surveys, while that of women in richer households has increased in the 1998 survey relative to the 1987 survey. Furthermore, the differential in birth intervals between women in wealthier households is widening relative to women in poorer households. The conditional expected birth interval length for women in poorer households increased by 4.6 months to 49.2 months between the two surveys, while that for women in richer households increased by 6.8 months, to 58.2 months (Table 7.13).

Table 7.13 Conditional expected birth interval length (months) of women having a subsequent birth within 120 months, by survey date and number of consumer durables in the household

	Survey	
Number of durables	*1987-9*	*1998*
0 – 1	44.6	49.2
2 – 3	51.4	58.2

7.6.4 Results: Hypothesis Three – Violence and social instability

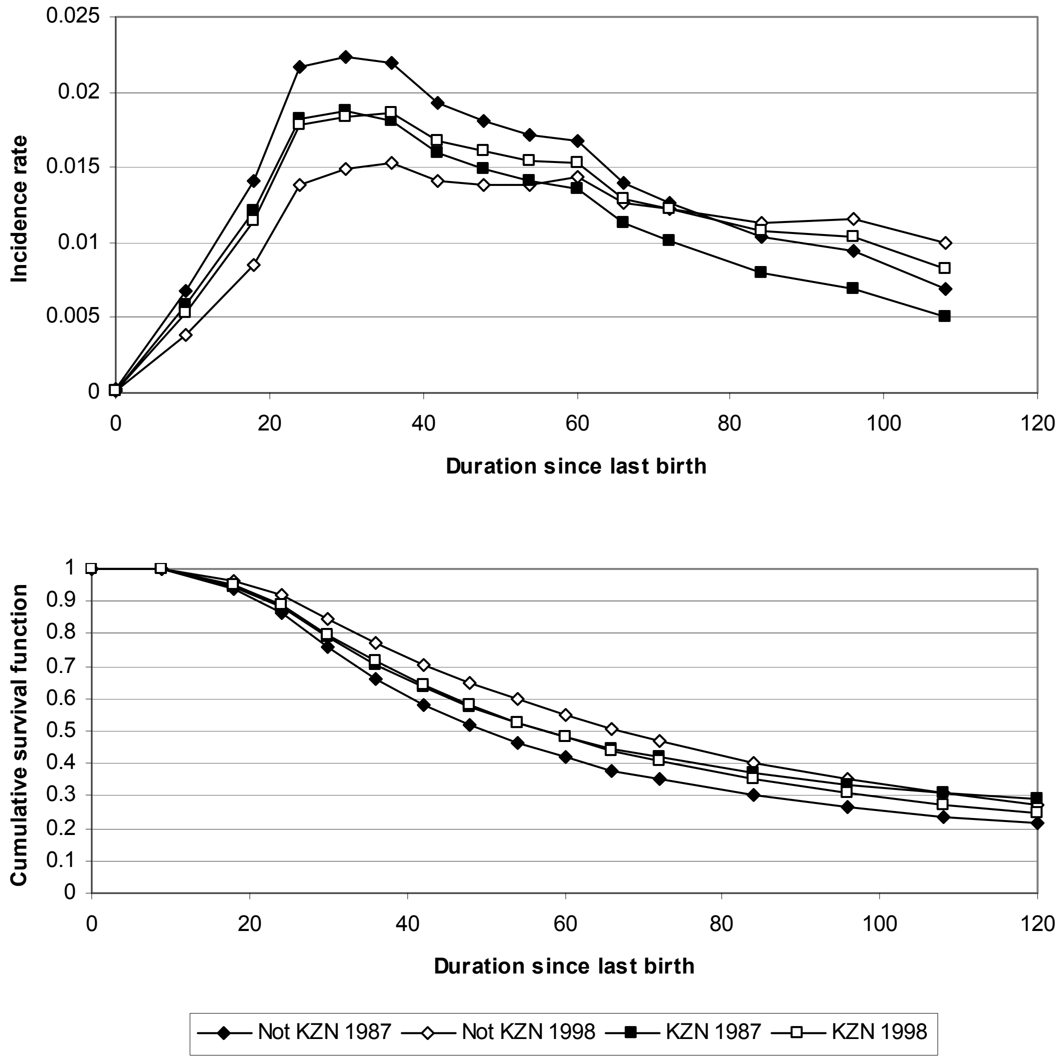
The third hypothesis posits that endemic violence and social disruption and instability might account for the continued increase in birth intervals after the end of apartheid. The hypothesis suggests that, since this violence was concentrated most intensely in the province of KwaZulu-Natal, and that that instability and violence may have led women to delay their childbearing, the differential between birth intervals in KwaZulu-Natal and those in other provinces would have widened.

The hypothesised variable-interval interaction effect does not produce a better fitting model. Thus, there is no statistically significant non-proportional difference between the distribution of childbearing between women in KwaZulu-Natal and those in other provinces. The variable-survey interaction, however, is significant. This shows that the differentials in patterns of childbearing between the two groups of women have changed in non-proportional ways.

A somewhat strange distribution of incidence rates and cumulative survival function can be seen in the data for KwaZulu-Natal in the 1987-9 survey (Figure 7.7), resulting in higher rates of non-progression by 120 months for these women than for any other group. Data errors for women in KwaZulu-Natal in the 1987-9 DHS cannot be excluded.

Nevertheless, the results shown here lead to the rejection of the hypothesis. Rather than indicating longer birth intervals in KwaZulu-Natal than other provinces, the model shows that women in KwaZulu-Natal surveyed in the 1998 DHS tend to progress faster to another birth than other women, while this pattern is reversed in the earlier survey.

Figure 7.7 Fitted incidence rates and cumulative survival functions by survey date and residence in KwaZulu-Natal



The distribution of incidence rates shows patterns of childbearing in both the 1987-9 and 1998 surveys similar to those identified in the testing of earlier hypotheses and in the base model. The distribution of childbearing in the later survey is much flatter than in the earlier survey. The conditional expected birth interval lengths are shown in Table 7.14.

From these data, it is apparent that despite the (possibly) greater proportion of women in KwaZulu-Natal not having a subsequent birth within 10 years of the last, the conditional expected interval length for those women who did have a birth within 10 years shows no difference between women in KwaZulu-Natal and those in other provinces in the 1987-9 survey. By contrast, in the 1998 survey, women in KwaZulu-Natal tended to have their births faster than women in other provinces.

Table 7.14 Conditional expected birth interval length (months) of women having a subsequent birth within 120 months, by survey date and province of residence

	Survey	
Province of residence	*1987-9*	*1998*
Not KwaZulu-Natal	46.2	54.5
KwaZulu-Natal	47.1	49.8

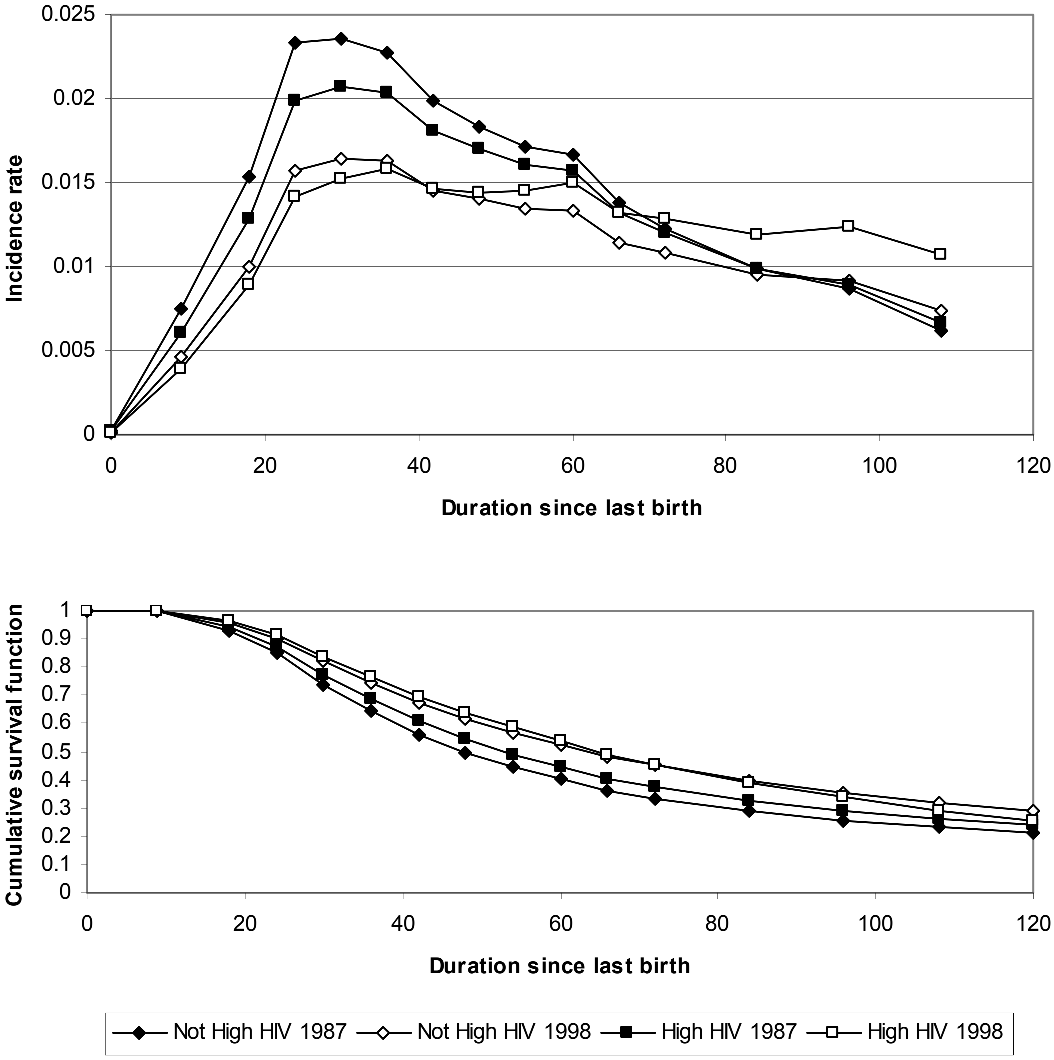
7.6.5 Results: Hypothesis Four – Disease and subfecundability

The final hypothesis is an inquiry into whether the spread of HIV in South Africa in the 1980s and 1990s has precipitated a shift in women's patterns of childbearing. It is proposed that, since infection with HIV inhibits conception, women living in provinces that show higher levels of HIV prevalence have longer birth intervals than women living in other provinces.

All three second-order interaction terms are significant in the model, as is the three-way interaction between variable, interval and survey.

The results from this model, and the implications for the validation of the hypothesis are striking. With the exception of women surveyed in 1998 living in provinces with high HIV prevalence, the pattern of child spacing is fundamentally similar. Only women living in high HIV provinces at the time of the later survey show a different pattern of child spacing (Figure 7.8), but in any event, this pattern suggests that women in these provinces have a greater hazard of having another birth later than other women. However, it is important to note, again, that the proportion of women not having a subsequent birth within 10 years of the last has hardly changed in any of the groups. Hence, women living in high HIV provinces delay their births more than other women, either by accident or by design, but show similar levels of parity progression ten years after the birth of the last child.

Figure 7.8 Fitted incidence rates and cumulative survival functions by survey date and residence in provinces with high levels of HIV prevalence



An examination of the conditional expected interval length shows that, among those women having a subsequent birth within 10 years, women living in high HIV prevalence provinces in both surveys tended to have longer birth intervals than those not living in these provinces. More significantly, however, the differential in conditional expectation between women in the two groups of provinces has widened slightly. Among women surveyed in the 1987-9 DHS, the provincial differential is 2.5 months. However, in the 1998 DHS, that differential is 3.2 months. Similarly, while these conditional expectations indicate that birth intervals in the low HIV prevalence provinces has increased by 6.3 months between the two surveys, those in high HIV provinces has increased by 7 months.

Table 7.15 Conditional expected birth interval length (months) of women having a subsequent birth within 120 months, by survey date and residence in provinces with high levels of HIV

	Survey	
Province of residence	*1987-9*	*1998*
Not high HIV	44.8	51.1
High HIV	47.3	54.3

Thus, there some evidence in support of this hypothesis on the grounds of ecological association. Other factors, of course, may account for the observed widening of the differential between this grouping of provinces. However, these groupings of provinces are not very homogeneous in other respects: both urbanised and rural provinces are included in the group of high HIV provinces. Moreover, there is no obvious linguistic compositional distinction between the two groups of provinces.

Thus, while the point can be made that higher levels of HIV prevalence are generally associated with bigger increases in conditional expected birth interval length, the results shown for areas with the highest levels of HIV prevalence indicate that higher HIV prevalence does not offer a complete explanation of the increase in birth intervals. This result, however, may not be as anomalous as it appears. Indeed, the very behaviours underlying high rates of HIV infection may be the very same as those resulting in a slower increase in birth intervals.

However, since data on individual women's sero-status were not collected in the 1998 DHS. Without these individual level data it is dangerous to draw firm conclusions about the association between HIV infection and women's birth intervals, and on the basis of the evidence presented above, the hypothesis should be rejected.

7.7 Discussion

This chapter sought to identify possible explanations for the continued increase in birth intervals in South Africa. Existing methods for investigating birth intervals were discussed, and an approach (using Poisson regression techniques) proposed that permits the comparison of data from more than one survey. Despite suffering from certain statistical limitations, described in Section 7.4, the method has proved extremely useful in highlighting trends and differentials in birth intervals among African South African women over the last few years.

Four hypotheses were proposed to explain the continued increase in birth intervals among African South Africans. The testing of the first hypothesis confirmed the existence of differentials in child spacing between ever-married and never-married women. However, the differential between these two groups of women has not widened between the two surveys. Birth intervals for both groups of women have increased by approximately the same amount, and hence changes in gender relations cannot account for the continued increase in birth intervals after the end of apartheid.

No evidence was found to contradict the second hypothesis. Women likely to have suffered least under apartheid (urban, educated and relatively wealthier women) have shown a large increase in their birth intervals, while intervals for other women have also lengthened, but by a lesser amount.

Third, it was hypothesised that that the continued increase in birth intervals might have been precipitated by violence and social instability. This hypothesis was also rejected. The conditional expected birth interval length among women living in the province most affected by violence and social stability (KwaZulu-Natal) increased by less than it did among women living in other provinces.

The evidence in support of the fourth hypothesis is unconvincing. Women living in provinces afflicted with high levels of HIV infection show longer birth intervals than women living in provinces with lower levels. However, the differential between the two groups of women has not widened substantially over the period of investigation covered by the two surveys. Further detailed research is necessary to investigate this hypothesis further, requiring a survey that captures detailed maternity histories and maternal sero-status.

However, in none of the four investigations conducted was an instance found where the survival function for women interviewed in the 1987-9 survey and that for women interviewed in 1998 overlapped. In other words, no group of women has been identified for whom patterns of childbearing have remained invariant over the period of investigation. This suggests that patterns of childbearing in South Africa after the end of apartheid have, in some sense, become institutionalised. African South African women's birth intervals have lengthened, irrespective of their marital status, their social status or their experience of conflict, although there does appear to be some association between the spread of HIV and the increase in birth intervals.

Chapter 2 argued that the forces of history exert long-term consequences. Robert Putnam (1993) was quoted as saying "individuals responding rationally to the social context bequeathed to them by history reinforce social pathologies". The continued increase in birth intervals in South Africa after the end of apartheid provides one telling demographic example of this.

8 CONCLUSIONS

The aim of this thesis was to detail the causes and institutional context of the South African fertility decline, and thereby to answer the question, "Why has fertility in South Africa fallen so slowly?". Three investigations were pursued, each of which has helped to cast light on the answer to that question. Substantive findings and conclusions have already been presented at the end of each chapter of this thesis. Consequently, the conclusions set out here will not simply repeat those findings, but concentrate instead on integrating them into a coherent story that answers the research question.

The first investigation was that into the level and past trend in South African fertility and birth intervals over the course of the fertility decline. Chapter 3 provided concrete evidence of the pace of the fertility decline in South Africa since the 1960s. The level of fertility has fallen gradually over an extended period of time. Over a quarter of a century, the level of fertility among African South Africans has fallen by less than half, from approximately 6 children per woman in 1970 to 3.5 children per woman in 1996. There are no obvious discontinuities in this trend associated with the implementation of the government's family planning programmes in 1974 and 1984. By this measure – the correct one, given the intensity of the government's desire to precipitate a rapid decline in African fertility – those programmes failed to meet their objectives despite their reputed strength and vigour.

Chapter 4 investigated the length of women's birth intervals using life table and other techniques. These results are certainly the most surprising presented in this thesis. African women's birth intervals have increased dramatically since the early 1970s. Furthermore, this increase has followed a secular trend discernible among all women, irrespective of their age or parity. The conclusion arrived at is not that women did not avail themselves of modern forms of contraception (they did), but that they did so to exercise greater control over the pace, not the quantity, of childbearing.

The results presented in these two chapters were compared and contrasted with demographic evidence from other African countries synthesised by Barney Cohen. While the age distribution of fertility among African South Africans is shown to be essentially similar to that in other countries in sub-Saharan Africa, the pattern of birth spacing, as evinced by the calculation of B_{60}s suggests that, at present, that pattern is dissimilar to that observed elsewhere in the region. However, the B_{60}s for those other

African countries that have entered the fertility transition show a similar shape across cohorts to those observed in South Africa, even if they indicate faster progression to a subsequent parity. Thus, although this was not a focal point of the thesis, the conclusion drawn is that the demography of South Africa cannot be regarded as being either *sui generis*, or typically African. Rather, South African fertility data both do and do not show similarities with those data from other African countries, depending on the measure adopted.

The second investigation examined the rhetoric, discourse and institutional context of reproduction that prevailed in South Africa under apartheid. The observed length of birth intervals impels the analysis of the South African fertility decline to accommodate institutional theory, and to investigate whether the underlying forces behind the apparent slowness of the fertility decline and the rise in birth intervals may have their explanation in the social structure of South African society. As argued in Chapters 5 and 6, the apparent anomalies of the South African fertility decline have an intuitive explanation when they are analysed using the theoretical framework first used by McNicoll.

According to this analysis, the slow pace of the South African fertility decline can be attributed to a range of institutional and structural factors. As a result of internal contradiction and policy changes over time, the state was never able to establish a firm grip on the African population and thereby manipulate the economics of the supply and demand for children. Government social and economic policies, whilst employing the rhetoric of modernisation and demographic transition theory, were generally inimical to rapid fertility decline. These policies (particularly those relating to influx control, education and urbanisation) had the effect of attenuating the potential benefits of modernisation.

As Chapters 2 and 5 have argued, no obvious reason exists as to why, with the range of theoretical positions on the causes and consequences of fertility decline available, the South African government should have adopted the particular demographic theorisations that it did. However, when these policies and practices are situated in their historical context, it becomes clear that the theoretical positions adopted by successive apartheid governments were those that were best suited to the quasi-scientific justifications that the government sought for its policies, while also reflecting its own identification with particular ideological positions in the international political environment.

Beyond the structural constraints on women's lives imposed by apartheid, the apartheid state's policies embodied neither of McNicoll's two paths of state-led fertility decline. State-individual relationships with Africans were not regularised. Equally, the state could not (and would not) use duress to dictate the pace of the South African fertility transition. Second, apartheid institutions had the (unintended) effect of precipitating an irrevocable transformation of gender relations between African men and women. Migrant labour, restrictions on urbanisation and forced removals distorted and disrupted the formation of stable households and relationships. By the early 1980s, large numbers of African women were living in households headed by themselves or by other women, and – in many respects – viewed men as superfluous. This change in gender relations is made clear, too, by women's adoption of modern contraceptive methods in the face of male opposition based on political and patriarchal views.

The family planning programmes implemented by apartheid governments offered African women a mechanism whereby they could assert a greater degree of control of their lives and their reproduction in a setting where the state and its institutional structures exercised huge power over individuals. Women's tenuous urban livelihoods, and poverty in rural areas, coupled with the state's intervention into, and obstruction of, family life meant that women sought modern contraceptive methods not to limit their fertility, but as an economic survival strategy.

Hence, this thesis has argued that the African populace used the government's family planning programmes for purposes other than those intended by apartheid planners. Despite the imbalance between structure and agency in the South African context, the dynamics of the South African fertility decline and women's responses to the institutional forces ranged against them suggest a Giddensian analysis of the dynamics of the South African fertility transition. The evolution and articulation of White fears that they were being swamped by African population growth precipitated state responses to those fears in the form of a system of generalised racism and implemented through apartheid policies and the government's family planning programmes. African women, however, were not simply the passive targets of these policies, responding mechanically to the state's bidding. Rather, as Giddens (1984, 1990) has theorised, individuals and the state recursively interacted with each other. With the failure of modernisation-led fertility decline, the state sought to alter African women's fertility preferences through the provision of contraception in the hope that they would avail themselves of these technologies to practice parity-specific fertility limitation. African women, however, saw this intervention as an opportunity to assert greater control over their lives in a way that made sense to them, and in ways that reconstituted their views of the world. African women's childbearing, as a result, was modified iteratively by their changing perceptions and experiences of the effects of apartheid social engineering. As we have seen, women also rationalised their responses to the provision of contraception, and the institutional forces set against them. In their discussion of gender relations, their own recasting of their position – with men occupying an increasingly peripheral space in the constitution of their quotidian realities – are indicative of this reflexivity in action. Hence, what has happened in the course of the South African fertility transition relates strongly to Giddens' assertion that

> the reflexivity of modern social life consists in the fact that social practices are constantly examined and reformed in the light of incoming information about those very practices, thus constitutively altering their character. (Giddens, 1990:38)

The third investigation was that into the continued increase in birth intervals in South Africa after the end of apartheid in 1990. The penultimate chapter applied statistical techniques to discern and elucidate the trends and differentials in the length of birth intervals over the last few decades. Differentials in women's birth intervals according to their marital and social status were identified. Birth intervals among women never married at the time of their giving birth were longer than those among married women. However, expected birth intervals do not seem to depend on women's propensity to engage in disrupted relationships. Internal instability in the country around the end of apartheid does not explain the increase. The spread of HIV in the country in the 1990s may have contributed to the lengthening of birth intervals. The further disentangling of this association could be a profitable line for further research.

No thesis on the recent or current demography of South Africa (or any other sub-Saharan African country, for that matter) can possibly be viewed as complete without some discussion of the impact of HIV/AIDS. Indeed, the critical reader of this thesis might feel that leaving such a crucial demographic cataclysm to the final paragraphs constitutes a serious error of omission on the part of the author. In the final analysis, however, this thesis has been largely reconstructive: understanding the process and dynamics underlying the South African fertility transition to date. Given that much of it has been focused on events in the (sometimes very) distant past, the neglect of the impact of HIV/AIDS is defensible. The first case of HIV/AIDS was diagnosed in South Africa in the mid-1980s, and the epidemic only started spreading dramatically in the mid- to late 1990s. As a result, the 1996 South Africa Census and the 1998 DHS data provide a demographic picture that is never to be regained: the demography of South Africa more or less untouched by the ravages of the disease. While the impact of HIV/AIDS-related mortality is still to work its way through onto the structure of the South African population, some evidence of its impact on the future demography of South Africa can be found in the differentials in women's patterns of child spacing described in Chapter 7.

What are the likely implications of the epidemic for future population growth, fertility levels and birth intervals? At this point the discussion has to enter the realm of informed speculation, although a couple of pointers are available. There is growing evidence from elsewhere in Africa that HIV has an inhibiting effect on fecundability. Already, birth intervals among South African women living in provinces with higher levels of HIV prevalence appear to be increasing. Given that in October 2000, around a quarter of women attending antenatal clinics in South Africa and around one in nine South Africans of all ages were infected with HIV, the spread of the epidemic must be assumed to limit at least some women's fertility. In the absence of an increase in fertility among uninfected women, this in itself would be adequate to precipitate a further fall in national fertility. However, when viewed against the backdrop of already exceptionally long birth intervals before the advent of HIV/AIDS, the impact of the epidemic on fertility in South Africa is likely to be even more dramatic. Were women to bear children in relatively quick succession, it would be possible for many women to bear a number of children before succumbing to infection, reduced fecundability and eventual death. Where women space their children by between five and eight years, however, the ability of women to bear large numbers of children is curtailed drastically.

A further methodological point in the measurement of fertility in countries with high levels of HIV infection will also come to the fore in the coming years. The most commonly used measure of fertility, the Total Fertility Rate (TFR), is not robust against increasing levels of mortality. Implicit in the formulation of the TFR is the assumption that maternal mortality is relatively low: it gives the number of children a woman may be expected to have by the end of her childbearing years, if she follows the experience of women older than she, and if she survives to menopause. With increasingly fewer numbers of women surviving to age 50, and increasing rates of HIV-associated subfecundability, demographers will need to ask themselves what the TFR really measures in these environments, and – if necessary – will need to develop new and more robust indicators of period-based fertility levels, cognisant of the fact that the TFR is not a measure of reproductivity.

The fundamental premise of this thesis was set out in the Introduction: that the pattern and process of fertility decline in South Africa could not be understood outside of the social and institutional context in which that decline has occurred.

The three investigations examined the historical dynamics of the South African fertility decline from a number of perspectives, all of which lead to the same conclusion. Apartheid population policies were ineffectual in hastening the pace of the South African fertility transition but have nonetheless continued to exercise a profound influence on African women's childbearing. Despite being widely praised for their reach and their implementation, the failure to integrate population policies into broader social, economic and political programmes meant that the institutional conditions of African women's lives under apartheid were not changed to be conducive to rapid fertility decline. Furthermore, the state lacked the legitimacy, and did not use the coercive capacity at its disposal, to encourage or force African women to limit their fertility. However, the rapid rate of uptake of modern contraception in South Africa from the mid-1960s onwards creates a paradox. African women did not use modern contraception for parity-specific fertility limitation, but neither did they use contraception for spacing their births according to the age of their youngest child. A new pattern of contraceptive use, ostensibly the product of women repeatedly deciding to go on delaying childbearing for now as an economic and social survival strategy, has been identified. The evolution of a pattern of very long (and increasing) median birth intervals among African South African women is held to be evidence of this.

The combination of apartheid policies, the institutional structure of South African society, and the subversion of the government's strong and vigorous family planning campaigns explains the dynamics of the South African fertility transition far better than simply appealing to any one of these forces, since they were reflexively bound up with, and continually mediated, each other. Further, the thesis has argued that the slow decline in fertility and the rapid rise in birth intervals are not incompatible with each other. Rather, the structural and institutional context in which African women found themselves in between 1960 and 1990 has resulted in a distinctive pattern of fertility decline and birth spacing that shows strong evidence of path-dependence.

Thus, the South African fertility decline provides further support for McNicoll's argument that fertility transition is innately and inherently institutional. Where social institutions are ill-conducive to fertility change, even the strongest family planning programme is likely to have a limited impact.

In a recent paper, John Casterline (1999:4) noted that "at present, there is little agreement about why some fertility declines are precipitous while others occur at a leisurely pace". This thesis has taken some small steps towards resolving this apparent conundrum. Taking South Africa as a single example, this thesis has argued that the underlying reason why the fertility decline has occurred slowly, even in the face of strong and vigorous family planning campaigns, is that the underlying institutional structure of South African society was not amenable to rapid changes in fertility. Certainly, this thesis has demonstrated that it is indeed hard, if not impossible, to evaluate thoroughly the dynamics of fertility decline in South Africa without keeping the institutional structure of South African society in the foreground.

The institutional approach to the analysis of fertility adopted here has allowed a nuanced picture of fertility changes in a given space over time to emerge. By avoiding a presumption of institutional stasis, analyses conducted using this approach are likely to be equally interested in both the absolute levels of fertility in a given population at a given time, as well as in the institutional and social forces that are in operation and which serve to affect the level of fertility over time.

South Africa provides, in many respects, an extreme case against which the role of institutions in the process of fertility decline can be assessed. The nature of many South African institutions over the course of the apartheid era facilitates that analysis, since the effect of the polity and other institutions on demographic outcomes are easier to divine and determine than would frequently be the case. State policies and institutions exerted an influence on demographic outcomes more directly than is usual even in developing countries. Other analyses that seek to demonstrate similar effects in other countries and other institutional settings will require somewhat subtler analyses.

The thesis adds to our knowledge in several significant ways. The level and trend of the past decline in fertility in South Africa is now known with greater certainty. In so doing, the quality of the fertility data in the 1996 South Africa Census has been subjected to rigorous investigation. Important lessons about the quality of those data have been learned. The estimates derived are a first step to accurate reporting and recording of levels and trends in fertility in South Africa.

Birth intervals in South Africa have been investigated for the first time. A (possibly unique) pattern of childbearing has been identified among African women, which is argued to be a response to the conditions under which they made reproductive decisions. Much information, which was previously solely at the disposal of Afrikaans-speaking South Africans, allowing the assessment of the decline in fertility in the country, has been made more generally accessible. As a result of the work presented in this thesis, it is hoped that our understanding of the fertility transition in South Africa, and the debate on the process and pattern of fertility decline in South Africa is advanced considerably.

The census conducted in South Africa in October 2001, together with subsequent Demographic and Health Surveys, will add considerably to the data available to researchers to assess the progress of the South African fertility decline, both nationally and in comparison with the declines evident in other African countries. It is hoped that other sources of data, which will permit thorough investigation into the consequences of HIV infection for fertility and childbearing, will also be collected in the coming years.

The historical evidence and institutional analysis strongly suggest that the principal reason underlying the slow pace of the South African fertility decline is that the social, political, economic and institutional structure of South African society was ill-conducive to rapid fertility decline. That structure, too, has precipitated the creation of a path-dependent pattern of child spacing in the country, characterised by increasing birth intervals and possibly now exacerbated by the spread of HIV.

REFERENCES

Ahn, Namkee and Abusaleh Shariff. 1993. "A comparative study of fertility determinants in Togo and Uganda: A hazards model analysis," In *International Population Conference 1993, Montreal*. Vol. 2. Liège: International Union for the Scientific Study of Population, pp. 319-333.

Anderson, Benedict. 1991. *Imagined Communities: Reflections on the Origins and Spread of Nationalism*. London: Verso.

Aoun, Samar. 1989a. *An Assessment of the Paired Comparison Procedure for Measuring Early Changes in Fertility in Syria, Tunisia and Yemen Arab Republic*. Centre for Population Studies Research Paper 89-2. London: Centre for Population Studies, London School of Hygiene & Tropical Medicine.

Aoun, Samar. 1989b. "A Comparative Study of Fertility Change in Tunisia, Syria and Yemen AR." Unpublished PhD dissertation, London: University of London.

Badenhorst, L.T. 1950. "The future growth of the population of South Africa and its probable age distribution", *Population Studies* **4**(1):3-46.

Bayart, Jean-François. 1992. *The State in Africa: The Politics of the Belly*. London: Longman.

Becker, Gary S. 1960. "An economic analysis of fertility," In *Demographic and Economic Change in Developed Countries*. Princeton: Princeton University Press, pp. 209-231.

Becker, Gary S. 1981. *A Treatise on the Family*. Cambridge: Harvard University Press.

Beinart, William. 1994. *Twentieth-Century South Africa*. Oxford: Oxford University Press.

Beinart, William and Saul Dubow. 1995. "Introduction: the historiography of segregation and apartheid," In Beinart, William and Saul Dubow (eds). *Segregation and Apartheid in Twentieth-Century South Africa*. London: Routledge, pp. 1-24.

Bell, Morag. 1986. *Contemporary Africa: Development, Culture and the State*. London: Longman.

Ben-Porath, Yoram. 1980. "The F-connection: Family, friends, and firms and the organisation of exchange", *Population and Development Review* **6**(1):1-30.

Bernstein, Hilda. 1975. *For Their Triumphs and For Their Tears: Conditions and Resistance of Women in Apartheid South Africa*. London: International Defence and Aid Fund.

Billig, Michael. 1979. *Psychology, Racism and Fascism*. Birmingham: A. F. & R. Publications.

Bogue, Donald J. 1993. "Fertility measurement by reverse survival of age-sex distributions," In Bogue, Donald, J., Eduardo E. Arriaga and Douglas Anderton, L. (eds). *Readings in Population Research Methodology*. Vol. 3. New York: United Nations Fund for Population Activities, pp. 11/39 - 11/42.

Bongaarts, John. 1982. "The fertility-inhibiting effects of the intermediate fertility variables", *Studies in Family Planning* **13**(6-7):179-189.

Bongaarts, John. 1994. "The impact of population policies: Comment", *Population and Development Review* **20**(3):616-620.

Bongaarts, John. 1997. "The role of family planning programmes in contemporary fertility transitions," In Jones, G.W., R.M. Douglas, J.C. Caldwell and R.M. D'Souza (eds). *The Continuing Demographic Transition*. Oxford: Clarendon Press, pp. 422-443.

Bongaarts, John. 1999. "The fertility impact of changes in the timing of childbearing in the developing world", *Population Studies* **53**(3):277-289.

Bongaarts, John and Susan Cotts Watkins. 1996. "Social interactions and contemporary fertility transitions", *Population and Development Review* **22**(4):639-682.

Botha, J.L. and D. Bradshaw. 1985. "African vital statistics - a black hole?", *South African Medical Journal* **67**:977-981.

Bozzoli, Belinda. 1991. *Women of Phokeng: Consciousness, Life Strategy, and Migrancy in South Africa, 1900-1983*. London: James Currey.

Brass, William and Fatima Juárez. 1983. "Censored cohort parity progression ratios from birth histories", *Asian and Pacific Census Forum* **10**(1):5-12.

Brass, William, Fatima Juárez and Anne Scott. 1997. "An analysis of parity-dependent fertility falls in tropical Africa," In Jones, G.W., R.M. Douglas, J.C. Caldwell and R.M. D'Souza (eds). *The Continuing Demographic Transition*. Oxford: Clarendon Press, pp. 80-93.

Brown, Barbara B. 1987. "Facing the 'Black Peril': The politics of population control in South Africa", *Journal of Southern African Studies* **13**(3):256-273.

Bruwer, J.P. 1954. "Realistiese of kwantitatiewe bevolkingsbelied? [Realistic or quantitative population policy?]", *Journal of Racial Affairs* **6**(1):17-23.

Bulatao, Rodolfo A. 1982. "The transition in the value of children and the fertility transition," In Höhn, Charlotte and Rainer Mackensen (eds). *Determinants of Fertility Trends: Theories Re-examined*. Liège: Ordina Editions, pp. 95-123.

Caldwell, John C. 1982. *Theory of Fertility Decline*. New York: Academic Press.

Caldwell, John C. 1994. *The course and causes of fertility decline*. IUSSP Distinguished Lecture Series on Population and Development. Liège: International Union for the Scientific Study of Population.

Caldwell, John C. and Pat Caldwell. 1993. "The South African fertility decline", *Population and Development Review* **19**(2):225-262.

Caldwell, John C., Israel O. Orubuloye and Pat Caldwell. 1992. "Fertility decline in Africa: A new type of transition?", *Population and Development Review* **18**(2):211-242.

Carter, A.T. 1995. "Agency and fertility: For an ethnography of practice," In Greenhalgh, Susan (ed). *Situating Fertility: Anthropology and Demographic Inquiry*. Cambridge: Cambridge University Press, pp. 55-85.

Casterline, John B. 1999. *The Onset and Pace of Fertility Transition: National Patterns in the Second Half of the Twentieth Century*. Policy Research Division Working Paper No.128. New York: Population Council.

Central Intelligence Agency. 2000. *World Factbook 2000*. http://www.cia.gov.

Centre for Population Studies. n.d. The P/F Ratio - Unpublished Lecture Notes. London School of Hygiene & Tropical Medicine.

Chimere-Dan, Orieji. 1993a. "Racial patterns of fertility decline in South Africa," In *International Population Conference 1993, Montreal.* Vol. 1. Liège: International Union for the Scientific Study of Population, pp. 43-51.

Chimere-Dan, Orieji. 1993b. "Population policy in South Africa", *Studies in Family Planning* **24**(1):31-39.

Chimere-Dan, Orieji. 1994. "Population policy in a divided society: The South African experience," Paper presented at Annual Meeting of the Population Association of America. Miami, Florida, May 5-7, 1994.

Cilliers, S.P. 1971. *Appeal to Reason.* Stellenbosch: University Publishers.

Coale, Ansley J., Paul Demeny and Barbara Vaughan. 1983. *Regional Model Life Tables and Stable Populations.* New York: Academic Press.

Coase, Ronald H. 1937. "The nature of the firm", *Economica* **4**:386-405.

Cohen, Barney. 1993. "Fertility levels, differentials, and trends," In Foote, Karen A., Kenneth H. Hill and Linda G. Martin (eds). *Demographic Change in Sub-Saharan Africa*. Washington DC: National Academy Press, pp. 8-67.

Courbage, Youssef. 2001. "Utilisation politique de l'analyse démographique des minorités [The political use of demographic analysis of minorities]," Paper presented at the XXIV General Population Conference of the International Union for the Scientific Study of Population. Salvador, Brazil, August 18-24, 2001.

Cox, D.R. 1972. "Regression models and life tables", *Journal of the Royal Statistical Society* **Series B-34**(2):187-220.

Davis, K. 1945. "The world demographic transition", *Annals of the American Academy of Political and Social Science* **273**:1-11.

Davis, K. and J. Blake. 1956. "Social structure and fertility: An analytic framework", *Economic Development and Cultural Change* **4**(4):211-235.

de Groot, Morris H. 1986. *Probability and Statistics (2nd Edition).* Reading: Addison-Wesley.

Department of Health. 1999. *South Africa Demographic and Health Survey 1998: Preliminary Report.* Pretoria: Department of Health.

Department of National Health and Population Development. 1991. "Abortions - An emotional volcano", *Epidemiological Comments* **18**(10):213-220.

Department of Welfare. 1998. *Population Policy for South Africa.* Pretoria: Department of Welfare.

Dobson, Annette J. 1990. *An Introduction to Generalized Linear Models.* London: Chapman & Hall.

Dorrington, Robert E. 1999. "Who was counted in? Some possible deficiencies with the 1996 South African Census results," Paper presented at Actuarial Society of South Africa Convention. Johannesburg, 2-3 November 1999.

Dorrington, Robert E., Debbie Bradshaw and Trevor J. Wegner. 1999. *Estimates of the Level and Shape of Mortality Rates in South Africa around 1985 and 1990 Derived by Applying Indirect Demographic Techniques to Reported Deaths*. Cape Town: Medical Research Council, Centre for Epidemiological Research in South Africa.

Dorrington, Robert E., Nadine Nannan and Debbie Bradshaw. 1999. "Current fertility rates in South Africa: 1996 Census revisited," Paper presented at Workshop on Phase 2 of Census 1996 Review. Johannesburg, South Africa, 3 - 4 December 1999.

Dubow, Saul. 1992. "Afrikaner nationalism, apartheid and the conceptualisation of race", *Journal of African History* **33**(2):209-237.

Dubow, Saul. 1995. "The elaboration of segregationist ideology," In Beinart, William and Saul Dubow (eds). *Segregation and Apartheid in Twentieth-Century South Africa*. London: Routledge, pp. 145-175.

Easterlin, Richard A. 1975. "An economic framework for fertility analysis", *Studies in Family Planning* **6**(3):54-63.

Easterlin, Richard A. 1978. "The economics and sociology of fertility: A synthesis," In Tilly, Charles (ed). *Historical Studies of Changing Fertility*. Princeton: Princeton University Press, pp. 57-133.

Easterlin, Richard A. (ed). 1980. *Population and Economic Change in Developing Countries*. Chicago: Chicago University Press.

Ehrlich, Paul R. 1968. *The Population Bomb*. New York: Ballantine.

El-Badry, M.A. 1961. "Failure of enumerators to make entries of zero: errors in recoding childless cases in population censuses", *Journal of the American Statistical Association* **56**(296):909-924.

Eloff, J.F. 1953a. "Die verandering en verval van die gesinslewe van die stedelike Bantoe [The change and consequence of family life among the urban Bantu]", *Journal of Racial Affairs* **4**(3):27-37.

Eloff, J.F. 1953b. "Die verandering en verval van die gesinslewe van die stedelike Bantoe (vervolg) [The change and consequence of family life among the urban Bantu (continued)]", *Journal of Racial Affairs* **4**(4):14-23.

Fapohunda, E.R and M.P Todaro. 1988. "Family structure, implicit contracts and the demand for children in Southern Nigeria", *Population and Development Review* **14**(4):571-594.

Feeney, Griffith. 1998. *A New Interpretation of Brass' P/F Ratio Method Applicable when Fertility is Declining*. http://www.gfeeney.com/notes/pfnote/pfnote.htm. Accessed: 11 January 2000.

Frome, E.L. 1983. "The analysis of rates using Poisson regression models", *Biometrics* **39**:665-674.

Fuller, Bruce. and Xiaoyan Liang. 1999. "Which girls stay in school? The influence of family economy, social demands and ethnicity in South Africa," In Bledsoe, C.H., J.B. Casterline, J.A. Johnson-Kuhn and J.G. Haaga (eds). *Critical Perspectives on Schooling and Fertility in the Developing World*. Washington DC: National Academy Press, pp. 181-215.

Garenne, Michel, Stephen M. Tollman and Kathleen Kahn. 2000. "Premarital fertility in rural South Africa: A challenge to existing population policy", *Studies in Family Planning* **31**(1):47-54.

Geraty, Alfreda. 1975. "Social factors influencing contraceptive usage in the Black population of Rhodesia", *South African Medical Journal* **49**(12):425-430.

Giddens, Anthony. 1984. *The Constitution of Society*. Berkeley: University of California Press.

Giddens, Anthony. 1990. *The Consequences of Modernity*. Cambridge: Polity Press.

Gilks, Walter R. 1986. "The relationship between birth history and current fertility in developing countries", *Population Studies* **40**(3):437-455.

Goldman, Noreen and John Hobcraft. 1982. *Birth Histories*. WFS Comparative Studies 17. Voorburg, Netherlands: International Statistical Institute.

Gray, Madi. 1980. "Race ratios: The politics of population control in South Africa," In Bondestam, Lars and Staffan Bergström (eds). *Poverty and Population Control*. New York: Academic Press, pp. 137-155.

Greene, Diana Lauren. 1998. "Contraceptive Use for Birth Spacing in Sub-Saharan Africa." Unpublished PhD dissertation, Princeton, NJ: Princeton University.

Greenhalgh, Susan. 1990. "Toward a political economy of fertility: Anthropological contributions", *Population and Development Review* **16**(1):85-106.

Greenhalgh, Susan. 1995a. "Afterword," In Greenhalgh, Susan (ed). *Situating Fertility: Anthropology and Demographic Inquiry*. Cambridge: Cambridge University Press, pp. 259-263.

Greenhalgh, Susan. 1995b. "Anthropology theorizes reproduction: Integrating practice, political economic and feminist perspectives," In Greenhalgh, Susan (ed). *Situating Fertility: Anthropology and Demographic Inquiry*. Cambridge: Cambridge University Press, pp. 3-28.

Guilkey, David K. and Ronald R. Rindfuss. 1987. "Logistic regression multivariate life tables: A communicable approach", *Sociological Methods and Research* **16**(2):276-300.

Hertzog, J.B.M. 1977 (1924). "Toespraak: Aanval op genl. J.C. Smuts en program van aksie van NP - Smithfield, 3 Mei 1924 [Speech: Attack on Gen. J.C. Smuts and programme of action of the NP - Smithfield, 3 May 1924]," In Spies, F.J. du T., D.W. Kruger and J.J. Oberholster (eds). *Die Hertzogtoesprake. Deel 4, April 1918 - Junie 1924 [The Hertzog Speeches. Part 4, April 1918 - June 1924]*. Johannesburg: Perskor, pp. 299-309.

Hertzog, J.B.M. 1977 (1925). "Toespraak: Naturelle- en Kleurlingstemreg en -verteenwoordiging - Smithfield, 13 Nov. 1925 [Speech: The Native and Coloured franchise and representation - Smithfield, 13 Nov. 1925]," In Spies, F.J. du T., D.W. Kruger and J.J. Oberholster (eds). *Die Hertzogtoesprake. Deel 5, Julie 1925 - September 1932 [The Hertzog Speeches. Part 5, July 1925 - September 1932]*. Johannesburg: Perskor, pp. 17-36.

Hertzog, J.B.M. 1977 (1926). "Toespraak: Naturellewetgewing - Malmesbury, Mei 1926 [Speech: Native legislation - Malmesbury, May 1926]," In Spies, F.J. du T., D.W. Kruger and J.J. Oberholster (eds). *Die Hertzogtoesprake. Deel 5, Julie 1925 - September 1932 [The Hertzog Speeches. Part 5, July 1925 - September 1932].* Johannesburg: Perskor, pp. 71-77.

Hobcraft, John and John McDonald. 1984. *Birth Intervals*. WFS Comparative Studies 28. Voorburg, Netherlands: International Statistical Institute.

Hobcraft, John and Mike Murphy. 1986. "Demographic event history analysis: A selective review", *Population Index* **52**(1):3-27.

Holford, Theodore R. 1980. "The analysis of rates and of survivorship using log-linear models", *Biometrics* **36**:299-305.

Hyden, Goran. 1983. *No Shortcuts to Progress: African Development Management in Perspective.* Berkeley: University of California Press.

James, Deborah and Carol Kaufman. 1997. "The reproductive consequences of shifting ethnic identity in South Africa: Linking numerical and interpretive data," Paper presented at Population Association of America 1997 Annual Meeting. Washington D.C., 27-29 March 1997.

Jewkes, Rachel, Katharine Wood and N. Fidelia Maforah. 1997. "Backstreet abortion in South Africa", *South African Medical Journal* **87**(4):417-418.

Kalbfleisch, John D. and Ross L. Prentice. 1980. *The Statistical Analysis of Failure Time Data.* New York: John Wiley and Sons.

Kark, S.L. 1949. "The social pathology of syphilis in Africans", *South African Medical Journal* **23**:77-84.

Kaufman, Carol E. 1996. "The Politics and Practice of Reproductive Control in South Africa: A Multilevel Analysis of Fertility and Contraceptive Use." Unpublished PhD dissertation, Ann Arbor: University of Michigan.

Kaufman, Carol E. 1997. *1987-9 South African Demographic and Health Survey: Methodology and Data Quality*. Report No. 97-395. University of Michigan: Population Studies Center.

Kaufman, Carol E. 1998. "Contraceptive use in South Africa under apartheid", *Demography* **35**(4):421-434.

Kaufman, Carol E. 2000. "Reproductive control in apartheid South Africa", *Population Studies* **54**(1):105-114.

Keegan, Timothy J. 1988. *Facing the Storm: Portraits of Black Lives in Rural South Africa.* Claremont: David Philip.

Kirk, Dudley and Bernard Pillet. 1998. "Fertility levels, trends and differentials in sub-Saharan Africa in the 1980s and 1990s", *Studies in Family Planning* **29**(1):1-22.

Knowles, James C., John S. Akin and David K. Guilkey. 1994. "The impact of population policies: Comment", *Population and Development Review* **20**(3):611-615.

Kuckertz, Heinz. 1990. *Creating Order: The Image of the Homestead in Mpondo Traditional Life.* Johannesburg: Witwatersrand University Press.

Legassick, Martin. 1995. "British hegemony and the origins of segregation in South Africa, 1901-14," In Beinart, William and Saul Dubow (eds). *Segregation and Apartheid in Twentieth Century South Africa*. London: Routledge, pp. 43-59.

Lesthaeghe, R.J. 1984. *Fertility and its proximate determinants in sub-Saharan Africa: The record of the 1960s and 70s*. IPD Working Paper 1984-2. Brussels: Vrije Universiteit Brussel, Interuniversity Programme in Demography.

Lesthaeghe, R.J. 1989. "Production and reproduction in sub-Saharan Africa: An overview of organizing principles," In Lesthaeghe, R.J. (ed). *Reproduction and Social Organization in Sub-Saharan Africa*. Berkeley: University of California Press, pp. 13-59.

Lesthaeghe, R.J. and F. Eelens. 1985. *Social Organisation and Reproductive Regimes: Lessons from sub-Saharan Africa and historical Western Europe*. IPD Working Paper 1985-1. Brussels: Vrije Universiteit Brussel, Interuniversity Programme in Demography.

Lesthaeghe, R.J. and J. Surkyn. 1988. *Exchange, production and reproduction: Women in Sub-Saharan demographic regimes*. IPD Working Paper 1988-1. Brussels: Vrije Universiteit Brussels, Interuniversity Programme in Demography.

'Letsema'. 1982. "Family planning in South Africa - A kind of genocide?", *African Communist* **90**:73-88.

Lipton, Merle. 1985. *Capitalism and Apartheid: South Africa, 1910-1986*. Aldershot: Wildwood House.

Locoh, Thérèse. 1994. "Will the decline in fertility in sub-Saharan Africa last? A time of uncertainty," In Locoh, Thérèse and Véronique Hertrich (eds). *The Onset of Fertility Transition in Sub-Saharan Africa*. Liège, Belgium: Derouaux Ordina Editions, pp. 105-133.

Lonsdale, John. 1981. "States and social processes in Africa: A historiographical survey", *African Studies Review* **24**(2-3):140-225.

Lötter, J.M. and J.L. van Tonder. 1976. *Fertility and Family Planning among Blacks in South Africa: 1974*. Report S-39. Pretoria: Human Sciences Research Council.

Lucas, David. 1992. "Fertility and family planning in Southern and Central Africa", *Studies in Family Planning* **23**(3):145-158.

Mason, Karen Oppenheim. 1997. "Explaining fertility transition", *Demography* **34**(4):443-454.

Maylam, Paul. 1995. "Explaining the apartheid city: 20 years of South African urban historiography", *Journal of Southern African Studies* **21**(1):19-38.

McNicoll, Geoffrey. 1980. "Institutional determinants of fertility change", *Population and Development Review* **6**(3):441-462.

McNicoll, Geoffrey. 1992. "The agenda of population studies: a commentary and complaint", *Population and Development Review* **18**(3):399-420.

McNicoll, Geoffrey. 1994. "Institutional analysis of fertility," In Lindahl-Kiessling, Kerstin and Hans Landberg (eds). *Population, Economic Development and the Environment*. Oxford: Oxford University Press, pp. 199-230.

McNicoll, Geoffrey. 1996. *Governance of Fertility Transition: Regularity and Duress*. Policy Research Division Working Paper No.85. New York: Population Council.

McNicoll, Geoffrey. 1998. *Government and Fertility in Transitional and Post-Transitional Societies*. Policy Research Division Working Paper No.113. New York: Population Council.

Mencarini, Letizia. 1999. "An analysis of fertility and infant mortality in South Africa based on 1993 LSDS data," Paper presented at Third African Population Conference. Durban, South Africa, 6 - 10 December 1999. Union for African Population Studies. Vol. 1:109-127.

Millman, S.R. and R.G. Potter. 1984. "The fertility impact of spousal separation", *Studies in Family Planning* **15**(3):121-126.

Mostert, W.P. 1972. *Die Gesinsbouproses by Bantoes in die Metropolitaanse Gebied van Durban [The Family Building Process among Bantus in the Metropolitan Area of Durban]*. Report S-16 (1972). Pretoria: Human Sciences Research Council.

Mostert, W.P. 1978. "Gesinsbeplanning in 1977 [Family planning in 1977]", *Journal of Racial Affairs* **29**(3):86-88.

Mostert, W.P. 1979. "Dalende bevolkingsgroeitempo - Nuwe hoop? [Declining population growth rate - New hope?]", *Journal of Racial Affairs* **30**(1):36-38.

Mostert, W.P. and J.L. du Plessis. 1972. *Die Gesinsbouproses by Bantoes in die Metropolitaanse Gebied van Pretoria [The Family Building Process among Bantus in the Metropolitan Area of Pretoria]*. Report S-17 (1972). Pretoria: Human Sciences Research Council.

Mostert, W.P. and J. Engelbrecht. 1972. *Die Gesinsbouproses by Bantoes in die Metropolitaanse Gebied van Kaapstad [The Family Building Process among Bantus in the Metropolitan Area of Cape Town]*. Report S-15 (1972). Pretoria: Human Sciences Research Council.

Mostert, W.P., B.E. Hofmeyr, J.S. Oosthuizen and J.A. van Zyl. 1998. *Demography: Textbook for the South African Student*. Pretoria: Human Sciences Research Council.

Mostert, W.P. and J.M. Lötter (eds). 1990. *South Africa's Demographic Future*. Pretoria: Human Sciences Research Council.

Mostert, W.P. and I.J. van Eeden. 1972. *Die Gesinsbouproses by Bantoes in die Metropolitaanse Gebied van Johannesburg: Soweto [The Family Building Process among Bantus in the Metropolitan Area of Johannesburg: Soweto]*. Report S-18 (1972). Pretoria: Human Sciences Research Council.

Mostert, W.P., I.J. van Eeden and J.L. van Tonder. 1973a. *Bevolkingsprojeksies vir die Bantoebevolkings in die Onderskeie Bantoetuislande en in die Blanke Gebied van Suid-Afrika, 1970-2010 [Population Projections for the Bantu Populations in the Various Homelands and in the White Area of South Africa, 1970-2010]*. Report SN-29 (1973). Pretoria: Human Sciences Research Council.

Mostert, W.P., I.J. van Eeden and J.L. van Tonder. 1973b. *Bevolkingsprojeksies vir Suid-Afrika, 1970-2010 [Population Projections for South Africa, 1970-2010]*. Report SN-24 (1973). Pretoria: Human Sciences Research Council.

Mostert, W.P., J.L. van Tonder and B.E. Hofmeyr. 1987. *Rekonstruksie van die Sensusouderdomstrukture van die Suid-Afrikaanse Swart Bevolking: 1936 tot 1985 [Reconstruction of the Census Age Structure of the South African Black Population: 1936 to 1985]*. Report S-153 (1987). Pretoria: Human Sciences Research Council.

Mostert, W.P., J.L. van Tonder and B.E. Hofmeyr. 1988. "Demographic trends in South Africa," In Marais, H.C. (ed). *South Africa: Perspectives on the Future*. Pinetown: Owen Burgess, pp. 59-86.

Moultrie, Tom A. and Ian M. Timæus. 2001. "Fertility and living arrangements in South Africa", *Journal of Southern African Studies* **27**(2):207-223.

Murray, J.F. 1957. "Endemic syphilis or yaws?", *South African Medical Journal* **31**:821-824.

Muthwa, Sibongile W. 1995. "Economic Survival Strategies of Female-Headed Households: The Case of Soweto, South Africa." Unpublished PhD dissertation, London: School of Oriental and African Studies, University of London.

Nash, Eleanor S. 1990. "Teenage pregnancy - Need a child bear a child?", *South African Medical Journal* **77**(3):147-151.

Newell, Colin. 1988. *Methods and Models in Demography.* Chichester: John Wiley & Sons.

North, Douglass C. 1989. "Institutions and economic growth: An historical introduction", *World Development* **17**(9):1319-1332.

Notestein, F.W. 1945. "Population - The long view," In Schultz, Theodore W. (ed). *Food for the World.* Chicago: Chicago University Press, pp. 37-57.

Ofosu, Dickson Yaw. 1989. "Hazard Models Analysis of Birth Intervals: A Study Based on West African Data." Unpublished PhD dissertation, Canberra: Australian National University.

O'Meara, Dan. 1996. *Forty Lost Years: The Apartheid State and the Politics of the National Party 1948-1994*. Randburg: Ravan Press.

Oosthuizen, Kobus. 2000. "Demographic changes and sustainable land use in South Africa", *Genus* **56**(3-4):81-107.

Page, Hilary J. and Ron Lesthaeghe (eds). 1981. *Child-spacing in Tropical Africa: Traditions and Change.* London: Academic Press.

Palloni, Alberto. 1984. "Assessing the effects of intermediate variables on birth interval-specific measures of fertility", *Population Index* **50**(4):623-657.

Pauw, B.A. 1963. *The Second Generation: A Study of the Family Among Urbanized Bantu in East London.* Cape Town: Oxford University Press.

Pham-Kanter, G.B.T., M.H. Steinberg and R.C. Ballard. 1996. "Sexually transmitted diseases in South Africa", *Genitourinary Medicine* **72**(3):160-171.

Posel, Deborah. 1991. *The Making of Apartheid, 1948-1961: Conflict and Compromise.* Oxford: Clarendon Press.

Posel, Deborah. 1995. "The meaning of apartheid before 1948: Conflicting interests and forces within the Afrikaner Nationalist alliance," In Beinart, William and Saul Dubow (eds). *Segregation and Apartheid in Twentieth-Century South Africa*. London: Routledge, pp. 206-230.

Potter, Joseph E. 1977. "Problems in using birth-history analysis to estimate trends in fertility", *Population Studies* **31**(2):335-364.

Potter, Joseph E. 1983. "Effects of societal and community institutions on fertility," In Bulatao, Rodolfo A. and Ronald D. Lee (eds). *Determinants of Fertility in Developing Countries*. Vol. 2. New York: Academic Press, pp. 627-665.

Preston, Samuel H., Patrick Heuveline and Michel Guillot. 2001. *Demography: Measuring and Modelling Population Processes*. Oxford: Blackwell.

Preston-Whyte, Eleanor. 1978. "Families without marriage: A Zulu case-study," In Argyle, J. and E. Preston-Whyte (eds). *Social System and Tradition in Southern Africa*. Cape Town: Oxford University Press, pp. 55-85.

Preston-Whyte, Eleanor. 1988. "Culture, context and behaviour: Anthropological perspectives on fertility in Southern Africa", *Southern African Journal of Demography* **2**(1):13-23.

Preston-Whyte, Eleanor. 1994. "Qualitative studies of fertility and family planning in South Africa," Paper presented at Population Association of America 1994 Annual Meeting. Miami, Florida, May 5-7, 1994.

Pritchett, Lant H. 1994a. "Desired fertility and the impact of population policies", *Population and Development Review* **20**(1):1-55.

Pritchett, Lant H. 1994b. "The impact of population policies: Reply", *Population and Development Review* **20**(3):621-630.

Putnam, Robert D. 1993. *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton: Princeton University Press.

Putzel, James. 1997. "Accounting for the 'dark side' of social capital: Reading Robert Putnam on democracy", *Journal of International Development* **9**(7):939-949.

Rees, Helen, Judy Katzenellenbogen, Rosieda Shabodien, Rachel Jewkes *et al.* 1997. "The epidemiology of incomplete abortion in South Africa", *South African Medical Journal* **87**(4):432-437.

Rindfuss, Ronald R., James A. Palmore and Larry L. Bumpass. 1982. "Selectivity and the analysis of birth intervals from survey data", *Asian and Pacific Census Forum* **8**(3):5-6,8-10,15-16.

Rindfuss, Ronald R., James A. Palmore and Larry L. Bumpass. 1989. "Analysing birth intervals: Implications for demographic theory and data collection," In Stycos, J. Mayone (ed). *Demography as an Interdiscipline*. New Brunswick: Transaction Publishers, pp. 193-210.

Robbertse, P.M. 1969. "'n Suid-Afrikaanse bevolkingsbeleid [A South African population policy]", *Journal of Racial Affairs* **20**(1):49-62.

Rodríguez, Germán and John Hobcraft. 1980. *Illustrative Analysis: Life Table Analysis of Birth Intervals in Colombia*. WFS Scientific Reports No. 16. Voorburg, Netherlands: International Statistical Institute.

Rodríguez, Germán, John Hobcraft, John McDonald, Jane Menken *et al.* 1984. *A Comparative Analysis of Determinants of Birth Intervals*. WFS Comparative Studies 30. Voorburg, Netherlands: International Statistical Institute.

Sadie, Jan L. 1950. "The political arithmetic of the South African population", *Journal of Racial Affairs* **1**(4):3-8.

Sadie, Jan L. 1955. "Some notes on Bantu demography", *Journal of Racial Affairs* **6**(3):36-47.

Sadie, Jan L. 1970. "An evaluation of demographic data pertaining to the non-White population of South Africa (Part III)", *South African Journal of Economics* **38**(2):171-191.

Sadie, Jan L. 1973. *Projections of the South African Population 1970 - 2020*. Johannesburg: Industrial Development Corporation.

SALDRU. 1994. *South Africa Integrated Household Survey 1993.* Cape Town: University of Cape Town, Southern Africa Labour and Development Research Unit.

Schoenmaeckers, Ronny, Iqbal H. Shah, Ron Lesthaeghe and Oleko Tambashe. 1981. "The child-spacing tradition and the postpartum taboo in tropical Africa: anthropological evidence," In Page, Hilary J. and Ron Lesthaeghe (eds). *Child-spacing in Tropical Africa: Traditions and Change.* London: Academic Press,

Schultz, T.P. 1976. "Determinants of fertility: A micro-economic model of choice," In Coale, Ansley J. (ed). *Economic Factors in Population Growth.* New York: Wiley, pp. 89-124.

Schutte, P.C. 1978. "Bevolkingsgroei en indiensneming [Population growth and employment]", *Journal of Racial Affairs* **29**(3):81-85.

Sibanda, Amson and Tukufu Zuberi. 1999. "Contemporary fertility levels and trends in South Africa: Evidence from reconstructed census birth histories," Paper presented at Third African Population Conference. Durban, South Africa, 6 - 10 December 1999. Union for African Population Studies. Vol. 1:79-108.

Simkins, Charles E.W. 1983. *Four Essays on the Past, Present & Possible Future of the Distribution of the Black Population of South Africa.* Cape Town: University of Cape Town, Southern Africa Labour and Development Research Unit.

Simon, Herbert A. 1955. "A behavioral model of rational choice", *Quarterly Journal of Economics* **69**(1):99-118.

Singer, Judith D. and John B. Willett. 1991. "Modeling the days of our lives: Using survival analysis when designing and analysing longitudinal studies of duration and timing of events", *Psychological Bulletin* **110**(2):268-290.

Singh, K.K., C.M. Suchindran, V. Singh and R. Ramakumar. 1993. "Analysis of birth intervals in India's Uttar Pradesh and Kerala States", *Journal of Biosocial Science* **25**(2):143-153.

South Africa, Republic of. 1965. *State of South Africa: Economic, Financial and Statistical Year-Book for the Republic of South Africa.* Johannesburg: Da Gama Publishers.

South Africa, Republic of. 1978. *State of South Africa: Economic, Financial and Statistical Year-Book for the Republic of South Africa.* Johannesburg: Da Gama Publishers.

South Africa, Republic of. 1983. *Report of the Science Committee of the President's Council on Demographic Trends in South Africa.* Cape Town: Government Printer.

South Africa, Union of. 1955. *Summary of the Report of the Commission for the Socio-Economic Development of the Bantu within the Union of South Africa*. Pretoria: Government Printer.

South Africa, Union of. 1958. *State of the Union: Economic, Financial and Statistical Year-Book for the Union of South Africa.* Cape Town: Culemborg Publishers.

South African Bureau of Racial Affairs. 1949a. "Die totstandkoming, ontwikkeling en toekomsplanne van SABRA [The creation, development and future plans of SABRA]", *Journal of Racial Affairs* **1**(1):3-6.

South African Bureau of Racial Affairs. 1949b. "Van die redaksie [Editorial]", *Journal of Racial Affairs* **1**(1):1-2.

Spiegel, Andrew, Vanessa Watson and Peter Wilkinson. 1996. "Domestic diversity and fluidity among some African households in Greater Cape Town", *Social Dynamics* **22**(1):7-30.

Statistics South Africa. 1998a. *The People of South Africa: Population Census 1996 - Calculating the Undercount in Census '96*. Report 03-01-18 (1996). Pretoria: Statistics South Africa.

Statistics South Africa. 1998b. *The People of South Africa: Population Census 1996, 10% Sample of Unit Records*. Report 03-01-13 (1996). Pretoria: Statistics South Africa.

Statistics South Africa. 2001. *Recorded Births 1998-2000*. Statistical Releases - P0305. Pretoria: Statistics South Africa.

Swanson, Maynard W. 1977. "The sanitation syndrome: bubonic plague and urban native policy in the Cape Colony, 1900-1909", *Journal of African History* **18**(3):387-410.

Szreter, Simon. 1993. "The idea of demographic transition and the study of fertility change: a critical intellectual history", *Population and Development Review* **19**(4):659-701.

Theal, George McCall. 1910. *The Yellow and Dark-Skinned People of Africa South of the Zambezi.* London: Swan Sonnenschein.

Timæus, Ian M. 1984a. *Mortality in Lesotho: A Study of Levels, Trends and Differentials Based on Retrospective Survey Data*. WFS Scientific Reports 59. Voorburg, Netherlands: International Statistical Institute.

Timæus, Ian M. 1984b. "A population policy for South Africa?", *People* **11**(4):33.

Timæus, Ian M., Rob Dorrington, Debbie Bradshaw and Nadine Nannan. forthcoming. *Mortality in South Africa, 1985-1997: From Apartheid to AIDS*. Cape Town: Medical Research Council.

Timæus, Ian. M. and Wendy Graham. 1989. "Labor circulation, marriage, and fertility in Southern Africa," In Lesthaeghe, R.J. (ed). *Reproduction and Social Organization in Sub-Saharan Africa*. Berkeley: University of California Press, pp. 365-400.

Trussell, James. 1984. "Estimating the determinants of birth interval length," Paper presented at the Seminar on Integrating Proximate Determinants into the Analysis of Fertility Levels and Trends. London, 29 April - 1 May 1984. International Union for the Scientific Study of Population.

Trussell, James and Charles Hammerslough. 1983. "A hazards-model analysis of the covariates of infant and child mortality in Sri Lanka", *Demography* **20**(1):1-26.

Trussell, James, Etienne van de Walle and Francine van de Walle. 1989. "Norms and behaviour in Burkinabe fertility", *Population Studies* **43**(3):429-454.

Udjo, Eric O. 1997. *Fertility and Mortality Trends in South Africa: The Evidence from the 1995 October Household Survey, and Implications on Population Projections*. Pretoria: Statistics South Africa.

Udjo, Eric O. 1998. *The People of South Africa - Population Census 1996: Additional Evidence Regarding Fertility and Mortality Trends in South Africa and Implications for Population Projections*. Pretoria: Statistics South Africa, Directorate of Analysis.

United Nations. 1993. "Estimates of Fertility Based on Information About Children Ever Born," In Bogue, Donald J., Eduardo E. Arriaga and Douglas L. Anderton (eds). *Readings in Population Research Methodology*. Vol. 3. Chicago: United Nations Population Fund, pp. 11/11 - 11/17.

United Nations, Centre for Human Settlements. 1996. *An Urbanizing World: Global Report on Human Settlements.* Oxford: Oxford University Press.

United Nations, Department of International Economic and Social Affairs. 1983. "The El-Badry Correction for Children Ever Born," In *Manual X: Indirect Techniques for Demographic Estimation, Annex II*. New York: United Nations, pp. 230-235.

US Bureau of the Census. 2001. *International Database*. Washington DC: International Programs Center. http://www.census.gov/ipc/www/idbnew.html. Accessed 06 July 2001.

van de Kaa, D.J. 1996. "Anchored narratives: The story and findings of half a century of research into the determinants of fertility", *Population Studies* **50**(3):389-432.

van der Vliet, Virginia. 1991. "Traditional husbands, modern wives - constructing marriages in a South African township", *African Studies* **50**(1-2):219-241.

van Dongen, L. 1975. "Thoughts on contraception and family planning clinics", *South African Medical Journal* **49**(12):422-425.

van Rensburg, Nic J. 1972. *Population Explosion in Southern Africa.* Pretoria: J.L. van Schaik.

van Tonder, J.L. 1985. *Fertility Survey 1982: Data Concerning the Black Population of South Africa*. Report S-129. Pretoria: Human Sciences Research Council.

van Zyl, J.A. 1994. "History, scope and methodology of fertility and family planning surveys in South Africa," Paper presented at Population Association of America 1994 Annual Meeting. Miami, Florida, May 5-7, 1994.

Verwoerd, Hendrik F. 1975 (1954). "Speech in the Senate, June 7 1954," In Rose, Brian and Raymond Tunmer (eds). *Documents in South African Education*. Johannesburg: A.D. Donker, pp. 260-266.

Verwoerd, Hendrik F. 1978 (1962). "Speech in the House of Assembly on January 23rd 1962," In Lever, Henry (ed). *Readings in South African Society*. Johannesburg: Jonathan Ball, pp. 179-190.

Vukani Makhosikazi Collective. 1985. *South African Women on the Move.* London: Zed Books.

Wilkinson, D., S.S. Abdool Karim, A. Harrison, M. Lurie *et al.* 1999. "Unrecognised sexually transmitted infections in rural South Africa: A hidden epidemic", *Bulletin of the World Health Organisation* **77**(1):22-28.

Yamaguchi, Kazuo. 1991. *Event History Analysis.* London: Sage Publications.

Zaba, Basia. 1981. *Use of the Relational Gompertz Model in Analysing Fertility Data Collected in Retrospective Surveys*. Centre for Population Studies Research Paper 81-2. London: Centre for Population Studies, London School of Hygiene & Tropical Medicine.

Zaba, Basia and Simon Gregson. 1998. "Measuring the impact of HIV on fertility in Africa", *AIDS* **12**(suppl 1):S41-S50.

APPENDIX 1 PARAMETERS OF MODELS FITTED IN CHAPTER 7

The following tables set out the six models fitted to the data in Chapter 7. Note, that as described in that chapter, the model fitting process sought to find the most parsimonious model for each hypothesis, taking the "base" model as fixed. The specification of each model was determined through likelihood ratio tests. Hence, some variables included in these models might not appear to be significant, but likelihood ratio tests showed that their omission would result in significantly worse-fitting models.

Table A1 presents the results from the base model fitted in Section 7.6.1. Table A2 present the results of the model specified to test the first two hypotheses in Sections 7.6. Tables A3 and A4 show the results of the models specified to test the third and fourth hypotheses.

Table A1 Model results – Base model

Negative binomial regression	**Number of observations**	**89891**
	LR chi2(46)	**4653.750**
	Prob > chi2	**0.000**
Log likelihood = -33979.228	**Pseudo R2**	**0.064**

PARAMETER	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
Interval (Base: 30)						
0	-5.120	0.192	-26.640	0.000	-5.497	-4.743
9	-1.491	0.061	-24.320	0.000	-1.612	-1.371
18	-0.649	0.053	-12.310	0.000	-0.753	-0.546
24	-0.126	0.047	-2.670	0.008	-0.218	-0.034
36	0.061	0.046	1.330	0.184	-0.029	0.151
42	0.017	0.048	0.360	0.721	-0.077	0.112
48	0.034	0.051	0.670	0.504	-0.066	0.135
54	0.066	0.055	1.190	0.234	-0.043	0.174
60	0.132	0.059	2.230	0.026	0.016	0.248
66	0.040	0.066	0.610	0.544	-0.090	0.170
72	0.040	0.064	0.630	0.530	-0.085	0.166
84	0.008	0.078	0.110	0.915	-0.145	0.162
96	0.099	0.091	1.090	0.277	-0.080	0.278
108		Dropped due to collinearity				
Survey (Base: 1987)						
1998	-0.840	0.068	-12.370	0.000	-0.973	-0.707
Duration (continuous, = 0 at interval = 27)	-0.017	0.002	-11.100	0.000	-0.020	-0.014
Interaction: Duration and Survey						
1998	0.021	0.002	8.700	0.000	0.017	0.026
Birth order (Base: 1 & 2)						
3 & 4	0.014	0.028	0.490	0.624	-0.042	0.070
5 & 6	-0.017	0.041	-0.420	0.673	-0.099	0.064
Age of mother (Base: 25-29)						
-15	-1.949	0.424	-4.600	0.000	-2.780	-1.119
15-19	-0.302	0.048	-6.330	0.000	-0.395	-0.208
20-24	-0.108	0.035	-3.050	0.002	-0.178	-0.039
30-34	-0.131	0.040	-3.300	0.001	-0.209	-0.053
35-39	-0.317	0.051	-6.180	0.000	-0.417	-0.216
40-44	-0.403	0.083	-4.880	0.000	-0.565	-0.241
45-49	-0.464	0.336	-1.380	0.167	-1.122	0.194
Interaction: Duration and Age of mother						
-15	-0.048	0.030	-1.600	0.110	-0.107	0.011
15-19	0.001	0.002	0.390	0.699	-0.004	0.006
20-24	0.001	0.001	0.860	0.387	-0.001	0.004
30-34	0.001	0.001	1.010	0.315	-0.001	0.004
35-39	-0.004	0.002	-2.690	0.007	-0.007	-0.001
40-44	-0.009	0.002	-3.600	0.000	-0.013	-0.004
45-49	-0.014	0.011	-1.280	0.200	-0.035	0.007
Linguistic group of mother (Base: Nguni)						
English/Afrikaans	-0.153	0.128	-1.190	0.234	-0.404	0.099
Sotho	-0.106	0.029	-3.710	0.000	-0.162	-0.050
Other African	0.069	0.047	1.480	0.138	-0.022	0.160
Interaction: Duration and Linguistic group						
English/Afrikaans	0.003	0.004	0.840	0.400	-0.004	0.011
Sotho	0.004	0.001	4.140	0.000	0.002	0.006
Other African	0.008	0.002	4.480	0.000	0.004	0.011
Childhood residence and survey (Base: Rural 1987)						
City 1987	-0.305	0.072	-4.240	0.000	-0.446	-0.164
City 1998	-0.278	0.109	-2.560	0.010	-0.491	-0.065
Town 1987	-0.339	0.036	-9.300	0.000	-0.411	-0.268
Town 1998		Dropped due to collinearity				
Rural 1998	0.580	0.070	8.250	0.000	0.442	0.718
Interaction: Duration and Childhood residence and survey						
City 1987	0.005	0.003	2.080	0.037	0.000	0.010
City 1998		Dropped due to collinearity				
Town 1987	0.004	0.001	3.040	0.002	0.001	0.007
Town 1998	-0.006	0.003	-1.920	0.055	-0.011	0.000
Rural 1998	-0.014	0.002	-5.590	0.000	-0.019	-0.009
Constant						
	-3.494	0.045	-77.370	0.000	-3.583	-3.406
/lnalpha	0.253	0.038			0.178	0.327
alpha	1.287	0.049			1.195	1.387
Likelihood ratio test of alpha=0	chibar2(01) =	1640.070			Prob>=chibar2	0.000

Table A2 Model results – Hypotheses One and Two (Marital and socio-economic status)

Negative binomial regression	Number of observations	87310
	LR chi2(79)	5510.050
	Prob > chi2	0.000
Log likelihood = -32602.315	Pseudo R2	0.078

PARAMETER	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
Interval (Base: 30)						
0	-5.171	0.193	-26.790	0.000	-5.550	-4.793
9	-1.538	0.063	-24.580	0.000	-1.660	-1.415
18	-0.660	0.053	-12.390	0.000	-0.764	-0.556
24	-0.135	0.047	-2.840	0.004	-0.228	-0.042
36	0.084	0.046	1.820	0.069	-0.007	0.174
42	0.052	0.048	1.070	0.283	-0.043	0.147
48	0.076	0.052	1.470	0.140	-0.025	0.177
54	0.110	0.056	1.990	0.047	0.001	0.219
60	0.178	0.060	2.980	0.003	0.061	0.295
66	0.086	0.067	1.290	0.197	-0.045	0.218
72	0.075	0.065	1.150	0.248	-0.052	0.201
84	0.049	0.079	0.620	0.536	-0.105	0.202
96	0.128	0.092	1.390	0.164	-0.052	0.307
108		Dropped due to collinearity				
Survey (Base: 1987)						
1998	-0.728	0.104	-6.970	0.000	-0.933	-0.523
Duration (continuous, = 0 at interval = 27)	-0.025	0.002	-12.220	0.000	-0.029	-0.021
Interaction: Duration and Survey						
1998	0.015	0.002	7.290	0.000	0.011	0.020
Birth order (Base: 1 & 2)						
3 & 4	-0.135	0.029	-4.610	0.000	-0.193	-0.078
5 & 6	-0.257	0.043	-6.010	0.000	-0.341	-0.173
Age of mother (Base: 25-29)						
-15	-1.743	0.418	-4.170	0.000	-2.562	-0.923
15-19	-0.166	0.049	-3.430	0.001	-0.262	-0.071
20-24	-0.061	0.036	-1.690	0.091	-0.131	0.010
30-34	-0.154	0.040	-3.820	0.000	-0.233	-0.075
35-39	-0.357	0.052	-6.820	0.000	-0.459	-0.254
40-44	-0.474	0.083	-5.680	0.000	-0.637	-0.310
45-49	-0.570	0.334	-1.710	0.088	-1.225	0.085
Interaction: Duration and Age of mother						
-15	-0.052	0.029	-1.790	0.074	-0.110	0.005
15-19	0.000	0.002	0.000	0.998	-0.005	0.005
20-24	0.001	0.001	0.940	0.348	-0.001	0.004
30-34	0.002	0.001	1.720	0.085	0.000	0.005
35-39	-0.002	0.002	-1.060	0.291	-0.005	0.001
40-44	-0.005	0.002	-2.150	0.031	-0.010	0.000
45-49	-0.010	0.011	-0.940	0.348	-0.031	0.011
Linguistic group of mother (Base: Nguni)						
English/Afrikaans	-0.146	0.133	-1.100	0.270	-0.407	0.114
Sotho	-0.111	0.041	-2.690	0.007	-0.192	-0.030
Other African	-0.021	0.060	-0.350	0.725	-0.138	0.096
Interaction: Duration and Linguistic group						
English/Afrikaans	0.004	0.004	1.040	0.298	-0.004	0.012
Sotho	0.004	0.001	4.300	0.000	0.002	0.006
Other African	0.009	0.002	5.090	0.000	0.006	0.012
Childhood residence and survey (Base: Rural 1987)						
City 1987	-0.049	0.078	-0.620	0.534	-0.202	0.105
City 1998		Dropped due to collinearity				
Town 1987	-0.179	0.042	-4.260	0.000	-0.261	-0.097
Town 1998	0.248	0.110	2.250	0.024	0.032	0.463
Rural 1998	0.533	0.099	5.400	0.000	0.339	0.726
Interaction: Duration and Childhood residence and survey						
City 1987	0.001	0.003	0.480	0.634	-0.004	0.006
City 1998	0.006	0.003	2.040	0.041	0.000	0.012
Town 1987	0.002	0.001	1.070	0.284	-0.001	0.004
Town 1998		Dropped due to collinearity				
Rural 1998	-0.005	0.002	-2.530	0.011	-0.009	-0.001
Province (Base: Gauteng)						
Western Cape	-0.092	0.080	-1.150	0.251	-0.249	0.065
Eastern Cape	0.105	0.055	1.900	0.057	-0.003	0.213
Northern Cape	0.031	0.106	0.300	0.767	-0.176	0.239
Free State	-0.164	0.054	-3.050	0.002	-0.269	-0.058
KwaZulu-Natal	-0.058	0.055	-1.060	0.288	-0.166	0.049
North-West	-0.037	0.050	-0.740	0.457	-0.135	0.061
Mpumalanga	-0.002	0.057	-0.030	0.974	-0.113	0.110
Northern Province	-0.016	0.049	-0.330	0.741	-0.112	0.079

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PARAMETER	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
Current residence (Base: Urban)						
Rural	0.029	0.035	0.820	0.410	-0.040	0.098
Interaction: Survey and Current residence						
Rural 1998	0.115	0.057	2.040	0.042	0.004	0.226
Education (Base: No education)						
Education up to St. 3 (Grade 5)	-0.054	0.045	-1.210	0.226	-0.142	0.034
Education up to St. 5 (Grade 7)	-0.131	0.044	-2.950	0.003	-0.218	-0.044
Education up to St. 9 (Grade 11)	-0.255	0.043	-5.910	0.000	-0.339	-0.170
Education up to St. 10 (Grade 12), or higher	-0.581	0.059	-9.830	0.000	-0.697	-0.465
Interaction: Duration and Education						
Education up to St. 3 (Grade 5)	0.003	0.002	1.870	0.062	0.000	0.006
Education up to St. 5 (Grade 7)	0.004	0.002	2.760	0.006	0.001	0.008
Education up to St. 9 (Grade 11)	0.006	0.002	3.950	0.000	0.003	0.009
Education up to St. 10 (Grade 12), or higher	0.008	0.002	3.980	0.000	0.004	0.012
Access to material resources (Base: 0 or 1 durable, 1987)						
0 or 1 durable, 1998		Dropped due to collinearity				
2 or 3 durables, 1987	-0.162	0.039	-4.150	0.000	-0.238	-0.085
2 or 3 durables, 1998	-0.359	0.052	-6.850	0.000	-0.462	-0.256
Interaction: Duration and Access to material resources						
0 or 1 durable, 1998	-0.003	0.002	-1.850	0.064	-0.006	0.000
2 or 3 durables, 1987	0.005	0.001	3.260	0.001	0.002	0.007
2 or 3 durables, 1998		Dropped due to collinearity				
Marital status (Base: Married)						
Never Married	-0.268	0.039	-6.830	0.000	-0.345	-0.191
Interaction: Duration and Marital status						
Never Married	0.008	0.001	6.440	0.000	0.006	0.010
Interaction: Survey and Marital status						
Never Married 1998	0.139	0.049	2.840	0.005	0.043	0.235
Propensity for marital disruption (Base: Married, 1 Union)						
Single, 0 unions	-0.526	0.044	-11.850	0.000	-0.613	-0.439
Divorced, Separated, Widowed, 1 union	-0.283	0.050	-5.630	0.000	-0.381	-0.184
Married, 1+ unions	-0.186	0.054	-3.470	0.001	-0.291	-0.081
Divorced, Separated, Widowed, 1+ unions	-0.162	0.111	-1.450	0.146	-0.380	0.056
Interaction: Duration and Propensity for marital disruption						
Single, 0 unions	-0.004	0.001	-3.000	0.003	-0.007	-0.001
Divorced, Separated, Widowed, 1 union	-0.003	0.002	-1.490	0.135	-0.006	0.001
Married, 1+ unions	0.002	0.002	0.820	0.413	-0.002	0.005
Divorced, Separated, Widowed, 1+ unions	-0.005	0.004	-1.350	0.177	-0.013	0.002
Constant						
	-3.026	0.077	-39.050	0.000	-3.177	-2.874
/lnalpha	0.097	0.042			0.016	0.179
alpha	1.102	0.046			1.016	1.196
Likelihood ratio test of alpha=0	chibar2(01)=	1223.47			Prob>=chibar2 =	0.000

Table A3 Model results – Hypothesis Three (Violence and social instability)

Negative binomial regression	**Number of observations**	**87310**
	LR chi2(73)	**5488.210**
	Prob > chi2	**0.000**
Log likelihood = -32613.235	**Pseudo R2**	**0.078**

PARAMETER	**Coefficient**	**Standard Error**	**z**	**P>z**	**95% Confidence Interval**	
Interval (Base: 30)						
0	-5.168	0.193	-26.780	0.000	-5.546	-4.790
9	-1.537	0.063	-24.560	0.000	-1.659	-1.414
18	-0.661	0.053	-12.400	0.000	-0.765	-0.556
24	-0.133	0.047	-2.820	0.005	-0.226	-0.041
36	0.083	0.046	1.800	0.072	-0.007	0.173
42	0.050	0.048	1.040	0.299	-0.045	0.145
48	0.075	0.052	1.460	0.146	-0.026	0.176
54	0.111	0.056	2.000	0.046	0.002	0.220
60	0.179	0.060	2.990	0.003	0.062	0.296
66	0.088	0.067	1.320	0.188	-0.043	0.219
72	0.077	0.065	1.180	0.236	-0.050	0.203
84	0.051	0.079	0.650	0.519	-0.103	0.205
96	0.128	0.092	1.390	0.164	-0.052	0.307
108		Dropped due to collinearity				
Survey (Base: 1987)						
1998	-0.751	0.104	-7.240	0.000	-0.954	-0.548
Duration (continuous, = 0 at interval = 27)	-0.025	0.002	-12.220	0.000	-0.029	-0.021
Interaction: Duration and Survey						
1998	0.016	0.002	7.300	0.000	0.011	0.020
Birth order (Base: 1 & 2)						
3 & 4	-0.132	0.029	-4.510	0.000	-0.190	-0.075
5 & 6	-0.256	0.043	-5.970	0.000	-0.339	-0.172
Age of mother (Base: 25-29)						
-15	-1.734	0.418	-4.150	0.000	-2.553	-0.915
15-19	-0.169	0.048	-3.490	0.000	-0.264	-0.074
20-24	-0.066	0.036	-1.840	0.065	-0.137	0.004
30-34	-0.151	0.040	-3.750	0.000	-0.230	-0.072
35-39	-0.352	0.052	-6.740	0.000	-0.455	-0.250
40-44	-0.465	0.083	-5.580	0.000	-0.629	-0.302
45-49	-0.550	0.334	-1.650	0.100	-1.205	0.105
Interaction: Duration and Age of mother						
-15	-0.052	0.029	-1.780	0.075	-0.110	0.005
15-19	0.000	0.002	0.100	0.921	-0.005	0.005
20-24	0.001	0.001	0.970	0.333	-0.001	0.004
30-34	0.002	0.001	1.730	0.084	0.000	0.005
35-39	-0.002	0.002	-1.030	0.304	-0.005	0.001
40-44	-0.005	0.002	-2.180	0.030	-0.010	-0.001
45-49	-0.010	0.011	-0.970	0.330	-0.031	0.011
Linguistic group of mother (Base: Nguni)						
English/Afrikaans	-0.186	0.132	-1.410	0.159	-0.444	0.073
Sotho	-0.178	0.031	-5.820	0.000	-0.238	-0.118
Other African	-0.074	0.049	-1.520	0.130	-0.169	0.022
Interaction: Duration and Linguistic group						
English/Afrikaans	0.004	0.004	1.040	0.299	-0.004	0.012
Sotho	0.004	0.001	4.400	0.000	0.002	0.006
Other African	0.009	0.002	5.110	0.000	0.006	0.013
Childhood residence and survey (Base: Rural 1987)						
City 1987	-0.077	0.076	-1.010	0.312	-0.226	0.072
City 1998		Dropped due to collinearity				
Town 1987	-0.193	0.042	-4.620	0.000	-0.275	-0.111
Town 1998	0.231	0.110	2.100	0.036	0.016	0.446
Rural 1998	0.523	0.098	5.310	0.000	0.330	0.716
Interaction: Duration and Childhood residence and survey						
City 1987	0.001	0.003	0.510	0.611	-0.004	0.007
City 1998	0.006	0.003	2.020	0.043	0.000	0.012
Town 1987	0.002	0.001	1.050	0.292	-0.001	0.004
Town 1998		Dropped due to collinearity				
Rural 1998	-0.005	0.002	-2.580	0.010	-0.009	-0.001

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PARAMETER	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
Current residence (Base: Urban)						
Rural	0.053	0.033	1.580	0.115	-0.013	0.118
Interaction: Survey and Current residence						
Rural 1998	0.118	0.056	2.090	0.036	0.007	0.228
Education (Base: No education)						
Education up to St. 3 (Grade 5)	-0.053	0.045	-1.190	0.235	-0.141	0.035
Education up to St. 5 (Grade 7)	-0.120	0.044	-2.710	0.007	-0.206	-0.033
Education up to St. 9 (Grade 11)	-0.239	0.043	-5.580	0.000	-0.323	-0.155
Education up to St. 10 (Grade 12), or higher	-0.555	0.059	-9.430	0.000	-0.670	-0.440
Interaction: Duration and Education						
Education up to St. 3 (Grade 5)	0.003	0.002	1.850	0.065	0.000	0.006
Education up to St. 5 (Grade 7)	0.004	0.002	2.650	0.008	0.001	0.007
Education up to St. 9 (Grade 11)	0.006	0.002	3.880	0.000	0.003	0.009
Education up to St. 10 (Grade 12), or higher	0.008	0.002	3.940	0.000	0.004	0.012
Access to material resources (Base: 0 or 1 durable, 1987)						
0 or 1 durable, 1998		Dropped due to collinearity				
2 or 3 durables, 1987	-0.170	0.039	-4.400	0.000	-0.246	-0.094
2 or 3 durables, 1998	-0.367	0.052	-7.000	0.000	-0.470	-0.264
Interaction: Duration and Access to material resources						
0 or 1 durable, 1998	-0.003	0.002	-1.810	0.070	-0.006	0.000
2 or 3 durables, 1987	0.005	0.001	3.220	0.001	0.002	0.007
2 or 3 durables, 1998		Dropped due to collinearity				
Marital status (Base: Married)						
Never Married	-0.266	0.039	-6.780	0.000	-0.343	-0.189
Interaction: Duration and Marital status						
Never Married	0.008	0.001	6.460	0.000	0.006	0.010
Interaction: Survey and Marital status						
Never Married 1998	0.129	0.049	2.620	0.009	0.033	0.226
Propensity for marital disruption (Base: Married, 1 Union)						
Single, 0 unions	-0.517	0.044	-11.660	0.000	-0.603	-0.430
Divorced, Separated, Widowed, 1 union	-0.283	0.050	-5.630	0.000	-0.381	-0.185
Married, 1+ unions	-0.192	0.053	-3.610	0.000	-0.297	-0.088
Divorced, Separated, Widowed, 1+ unions	-0.166	0.111	-1.500	0.135	-0.385	0.052
Interaction: Duration and Propensity for marital disruption						
Single, 0 unions	-0.004	0.001	-3.000	0.003	-0.007	-0.002
Divorced, Separated, Widowed, 1 union	-0.003	0.002	-1.520	0.129	-0.006	0.001
Married, 1+ unions	0.002	0.002	0.820	0.412	-0.002	0.005
Divorced, Separated, Widowed, 1+ unions	-0.006	0.004	-1.370	0.170	-0.013	0.002
Resident in KwaZulu Natal (Base: Not resident)						
Resident	-0.142	0.039	-3.600	0.000	-0.219	-0.065
Interaction: Resident in KwzZulu Natal and Survey						
Resident, 1998	0.145	0.061	2.360	0.018	0.024	0.265
Constant						
	-3.004	0.064	-47.300	0.000	-3.129	-2.880
/lnalpha	0.105	0.042			0.023	0.186
alpha	1.110	0.046			1.024	1.204
Likelihood ratio test of alpha=0	chibar2(01)=	1236.22			Prob>=chibar2	0.000

Table A4 Model results – Hypothesis Four (Disease and sub-fecundability)

Negative binomial regression	**Number of observations**	**87310**				
	LR chi2(75)	**5505.930**				
	Prob > chi2	**0.000**				
Log likelihood = -32604.372	**Pseudo R2**	**0.078**				

PARAMETER	**Coefficient**	**Standard Error**	**z**	**P>z**	**95% Confidence Interval**	
Interval (Base: 30)						
0	-5.172	0.193	-26.790	0.000	-5.551	-4.794
9	-1.539	0.063	-24.580	0.000	-1.662	-1.417
18	-0.661	0.053	-12.400	0.000	-0.766	-0.557
24	-0.134	0.047	-2.830	0.005	-0.227	-0.041
36	0.083	0.046	1.800	0.072	-0.007	0.173
42	0.051	0.048	1.060	0.290	-0.044	0.146
48	0.076	0.052	1.470	0.143	-0.026	0.177
54	0.110	0.056	1.980	0.048	0.001	0.219
60	0.177	0.060	2.960	0.003	0.060	0.294
66	0.086	0.067	1.280	0.201	-0.046	0.217
72	0.076	0.065	1.170	0.241	-0.051	0.203
84	0.052	0.079	0.670	0.506	-0.102	0.207
96	0.130	0.092	1.420	0.157	-0.050	0.310
108		Dropped due to collinearity				
Survey (Base: 1987)						
1998	-0.617	0.112	-5.520	0.000	-0.836	-0.398
Duration (continuous, = 0 at interval = 27)	-0.025	0.002	-11.780	0.000	-0.029	-0.021
Interaction: Duration and Survey						
1998	0.016	0.002	7.350	0.000	0.012	0.021
Birth order (Base: 1 & 2)						
3 & 4	-0.132	0.029	-4.510	0.000	-0.190	-0.075
5 & 6	-0.256	0.043	-5.970	0.000	-0.340	-0.172
Age of mother (Base: 25-29)						
-15	-1.730	0.418	-4.140	0.000	-2.549	-0.910
15-19	-0.161	0.048	-3.330	0.001	-0.256	-0.066
20-24	-0.061	0.036	-1.690	0.091	-0.131	0.010
30-34	-0.155	0.040	-3.850	0.000	-0.234	-0.076
35-39	-0.358	0.052	-6.840	0.000	-0.460	-0.255
40-44	-0.471	0.083	-5.650	0.000	-0.635	-0.308
45-49	-0.560	0.334	-1.680	0.093	-1.215	0.094
Interaction: Duration and Age of mother						
-15	-0.052	0.029	-1.780	0.074	-0.110	0.005
15-19	0.000	0.002	0.010	0.994	-0.005	0.005
20-24	0.001	0.001	0.880	0.380	-0.001	0.004
30-34	0.002	0.001	1.720	0.085	0.000	0.005
35-39	-0.002	0.002	-0.990	0.320	-0.005	0.002
40-44	-0.005	0.002	-2.190	0.029	-0.010	-0.001
45-49	-0.010	0.011	-0.970	0.330	-0.031	0.011
Linguistic group of mother (Base: Nguni)						
English/Afrikaans	-0.176	0.132	-1.330	0.182	-0.434	0.082
Sotho	-0.142	0.029	-4.850	0.000	-0.199	-0.084
Other African	-0.002	0.049	-0.040	0.968	-0.098	0.094
Interaction: Duration and Linguistic group						
English/Afrikaans	0.004	0.004	0.960	0.337	-0.004	0.011
Sotho	0.004	0.001	4.170	0.000	0.002	0.006
Other African	0.008	0.002	4.660	0.000	0.005	0.012
Childhood residence and survey (Base: Rural 1987)						
City 1987	-0.022	0.076	-0.290	0.774	-0.171	0.127
City 1998		Dropped due to collinearity				
Town 1987	-0.176	0.042	-4.210	0.000	-0.257	-0.094
Town 1998	0.233	0.110	2.130	0.033	0.018	0.448
Rural 1998	0.525	0.098	5.350	0.000	0.333	0.718
Interaction: Duration and Childhood residence and survey						
City 1987	0.001	0.003	0.510	0.612	-0.004	0.007
City 1998	0.006	0.003	2.020	0.043	0.000	0.012
Town 1987	0.001	0.001	1.000	0.319	-0.001	0.004
Town 1998		Dropped due to collinearity				
Rural 1998	-0.005	0.002	-2.540	0.011	-0.009	-0.001

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PARAMETER	Coefficient	Standard Error	z	P>z	95% Confidence Interval	
Current residence (Base: Urban)						
Rural	0.057	0.033	1.710	0.087	-0.008	0.123
Interaction: Survey and Current residence						
Rural 1998	0.105	0.056	1.860	0.063	-0.006	0.216
Education (Base: No education)						
Education up to St. 3 (Grade 5)	-0.062	0.045	-1.380	0.167	-0.150	0.026
Education up to St. 5 (Grade 7)	-0.135	0.044	-3.040	0.002	-0.222	-0.048
Education up to St. 9 (Grade 11)	-0.257	0.043	-5.980	0.000	-0.341	-0.172
Education up to St. 10 (Grade 12), or higher	-0.572	0.059	-9.710	0.000	-0.687	-0.456
Interaction: Duration and Education						
Education up to St. 3 (Grade 5)	0.003	0.002	1.870	0.061	0.000	0.006
Education up to St. 5 (Grade 7)	0.004	0.002	2.770	0.006	0.001	0.008
Education up to St. 9 (Grade 11)	0.006	0.002	3.960	0.000	0.003	0.009
Education up to St. 10 (Grade 12), or higher	0.008	0.002	3.960	0.000	0.004	0.012
Access to material resources (Base: 0 or 1 durable, 1987)						
0 or 1 durable, 1998		Dropped due to collinearity				
2 or 3 durables, 1987	-0.156	0.039	-4.020	0.000	-0.232	-0.080
2 or 3 durables, 1998	-0.365	0.052	-6.970	0.000	-0.468	-0.263
Interaction: Duration and Access to material resources						
0 or 1 durable, 1998	-0.003	0.002	-1.710	0.087	-0.006	0.000
2 or 3 durables, 1987	0.005	0.001	3.180	0.001	0.002	0.007
2 or 3 durables, 1998		Dropped due to collinearity				
Marital status (Base: Married)						
Never Married	-0.272	0.039	-6.950	0.000	-0.349	-0.196
Interaction: Duration and Marital status						
Never Married	0.008	0.001	6.400	0.000	0.006	0.010
Interaction: Survey and Marital status						
Never Married 1998	0.148	0.049	3.030	0.002	0.052	0.244
Propensity for marital disruption (Base: Married, 1 Union)						
Single, 0 unions	-0.530	0.044	-11.940	0.000	-0.617	-0.443
Divorced, Separated, Widowed, 1 union	-0.280	0.050	-5.570	0.000	-0.378	-0.181
Married, 1+ unions	-0.175	0.054	-3.260	0.001	-0.279	-0.070
Divorced, Separated, Widowed, 1+ unions	-0.150	0.111	-1.340	0.179	-0.368	0.069
Interaction: Duration and Propensity for marital disruption						
Single, 0 unions	-0.004	0.001	-2.990	0.003	-0.007	-0.001
Divorced, Separated, Widowed, 1 union	-0.003	0.002	-1.540	0.124	-0.006	0.001
Married, 1+ unions	0.001	0.002	0.650	0.515	-0.002	0.005
Divorced, Separated, Widowed, 1+ unions	-0.006	0.004	-1.440	0.149	-0.014	0.002
Resident in provinces with high HIV and Survey (Base: Resident, 1987)						
Not resident, 1987	0.153	0.034	4.450	0.000	0.085	0.220
Not resident, 1998		Dropped due to collinearity				
Resident, 1998	-0.063	0.054	-1.160	0.247	-0.169	0.043
Interaction: Resident in provinces with high HIV and duration						
Not resident, 1987	0.000	0.001	-0.110	0.915	-0.003	0.002
Not resident, 1998	-0.004	0.002	-2.320	0.020	-0.007	-0.001
Resident, 1998		Dropped due to collinearity				
Constant						
	-3.100	0.065	-47.730	0.000	-3.227	-2.972
/lnalpha	0.105	0.041			0.024	0.187
alpha	1.111	0.046			1.024	1.205
Likelihood ratio test of alpha=0	chibar2(01)=	1238.46			Prob>=chibar2	0.000