Fertility Differentials in South Africa: Effects of Race on Fertility, Evidence from National Income Dynamic Survey

Julius Chingwalu
Supervisor: A/Prof. Tom Moultrie
University of Cape Town

A dissertation submitted in partial fulfilment of the requirements for the degree of Master of Philosophy in Demography at the Centre for Actuarial Research

September 2011

PLAGIARISM DECLARATION

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.
2. I have used the Harvard convention for citation and referencing. Each contribution to, and quotation in, this report from the work(s) of other people has been attributed, and has been cited and referenced.
3. This report is my own work. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

Signature ..... Date ...../...../.....

ABSTRACT

Apartheid policies have been criticised for widening inequalities between population groups in South Africa. They have also been considered to have dictated differentials in demographic parameters. With lack of adequate data on social and economic variables in most demographic surveys including DHS, the use of race as a determinant of fertility seems plausible. With adequate data on social and economic factors, we use the NIDS survey to assess the effects of race on fertility once one has adequately controlled for social and economic factors. A logistic regression model is applied to assess the chance that a woman aged 20-24 has given birth by age 20, and the chance that a woman aged 25-29 has given birth by age 25. A linear regression model is also applied on the number of children born to a woman, standardised by age. The results show that the effect of race on fertility is not significant and that when controls for income and expenditure the effect of race is reduced further. They also show that African women's fertility is not homogenous and is affected by other factors.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to thank Professor Tom Moultrie who supervised this research. I am indebted to his criticism and technical assistance which has been valuable at all stages of the study. I am also grateful to the staff at CARe for their support during the programme. I would also like to thank the William and Flora Hewlett Foundation and the University of Cape Town Postgraduate Funding Office for sponsoring my studies.

I would also like to extend my gratitude to my family for their support. Special mention to Garvey and Gloria for being there for me. I would like to extend my appreciation to my classmates and friends who made my stay in Cape Town and UCT in particular a memorable one. My honour remains to God almighty who has seen me through the course of this study.

While I acknowledge the valuable contribution of all the people mentioned, all errors and/or interpretations remain my responsibility.

1 INTRODUCTION

1.1 Background

Demographic patterns in South Africa are stratified by race. Chimere-Dan (1993) notes that racial differentials existed prior to the introduction of apartheid policies and that Whites and Non-whites were at different stages of the demographic transition. For example, the total fertility rate of Whites in the 1940-50 period was 3.5 children compared to an average of 6.5 children for the other population groups (Chimere-Dan 1993). What apartheid policies did was to widen the differentials in the demographic patterns by race as race determined other proximate determinants.

Fertility in South Africa has been declining during the last four decades. Between 1970 and 1996, it declined by half to 3.2 children per woman (Moultrie and Timaeus 2003). Although the authors observe that parity progression ratios have fallen for all women of all achieved parities, they also observed the standardised fertility distributions differ by population group. The distributions for African and Coloured women were flat while those for White and Asian women were more concentrated around the mode. This signifies the differences in fertility levels among population groups. The fertility schedules imply that fertility is higher among African and Coloured women and lower among White and Asian women.

Other writers have also noted the differentials in South African fertility. Palamuleni, Kalule-Sabiti and Makiwane (2007) observe that there are differentials in fertility by education, childhood place of residence, province of residence, race and a woman's working status. They found that holding other factors constant, fertility is higher in provinces with a high proportion of African South Africans and is lowest in provinces with a high proportion of White South Africans. From this it can be inferred that race is important in explaining fertility differentials. In their analysis, they assumed that abortion is non-existent. This is an erroneous assumption as abortion is legalised in South Africa and hence it is practiced. Additionally, illegal abortion in South Africa is still practiced and therefore the assumption that abortion is non-existent is wrong (Dickson, Jewkes, Brown *et al.* 2003; Jewkes, Gumede, Westaway *et al.* 2005). Their results show that marital fertility is as high as 23.7 children among Asian women and 11.2 children among white women. These results are not realistic and therefore the conclusions noted above may not be realistic as well. Even if the conclusions were valid, one would want to investigate to see whether the conclusions still hold using new data

as the authors used data from the 1998 South African Demographic and Health Survey. The National Income Dynamics Survey (NIDS) data could provide better insights to whether race affects fertility.

1.2 Problem statement and justification

Levels of South African fertility have been noted to be different among different population groups and by other characteristics (Dorrington, Timaeus, Moultrie and Nannan 2004; Swartz 2002). Swartz (2002) observes that poverty and racial inequalities in South Africa still persist. It has also been argued that apartheid policies on urbanisation and 'homelands' led to provincial disparities in health, education, racial composition and socio-economic indicators (Moultrie and Timaeus 2003). Thus, the disparities caused by the policies and not the racial classification of an individual could account for the differentials in fertility.

The use of race as a proxy indicator for the socio-economic determinants of fertility has implications that race might be interpreted as a determinant of fertility. In the post-apartheid era, this could be wrong as apartheid policies that widened the racial disparities have been abolished. Much as one would argue that the effects of the policies might still be felt now, it is important to note that almost two decades have now passed since the abolition of those policies and hence the ground might be level for all South Africans of different population groups. Additionally, from the Bongaarts framework of the proximate determiants of fertility (Bongaarts 1982; Bongaarts and Potter 1983), race cannot be a proxy indicator. With the availability of adequate data, it is important to examine how much of the racial differentials observed in South African fertility are explained by the determinants for which race is just a proxy indicator.

NIDS data have been selected in this study because in most demographic surveys, including Demographic and Health Survey (DHS), household and individual economic information collected is limited. Measures of income and consumption expenditure are usually limited or unavailable in DHS data (Amin, Casterline and Spess 2007). This makes it difficult for one to understand social and economic dynamics as they relate to demographic variables. The NIDS survey has more detailed information on social and economic issues at household level. The data collected include information on women's birth histories, household relationships, employment, education status, race, income, and expenditure. This richness in socio-economic and fertility data provide a platform

for a better understanding of relationships between fertility and factors affecting its proximate determinants.

1.3 Objectives and Hypothesis:

The study objective is to examine the effect of race on fertility after controlling for other socio-economic factors and the proximate determinants of fertility.

The hypothesis to be tested is that when one controls for other background factors like education and income, race is not significant in determining fertility (as operationalised by both the number of children ever born and whether a woman has ever given birth).

1.4 Dissertation Outline

This dissertation is divided into five chapters. This chapter has provided the introduction to the connection between fertility and race, specifically giving the background to the dissertation, stating the problem, justifying the research and providing the objectives. Chapter 2 looks at the literature that is available on the topic. It begins by expounding on the proximate determinants of fertility, then looks at the socio-economic factors affecting fertility and lastly reviews the available literature on fertility in South Africa. Chapter 3 presents the discussion on data used in this study and examines the quality of the data. Chapter 4 presents results of the study and provides a discussion while chapter 5 provides a conclusion.

2 LITERATURE REVIEW

This chapter reviews the available literature on fertility and race. It pays particular attention to the proximate determinants of fertility, socio-economic factors affecting fertility and fertility and socioeconomic factors in South Africa.

2.1 Proximate determinants of fertility

Proximate determinants of fertility are defined as intermediate variables through which social, economic and environmental factors affect fertility (Davis and Blake 1956; Bongaarts and Potter 1983). Davis and Blake (1956) observe that the process of human reproduction has three steps: intercourse, conception and gestation and parturition. They state that in analysing factors affecting fertility, one should consider factors that are directly connected with these steps. From this perspective, Davis and Blake propose a set of eleven variables which can improve the understanding of the causes of fertility variations. The principle characteristic of these determinants of fertility is that they have a direct influence on fertility.

However, Bongaarts (1982) argues that differences in fertility among populations are largely due to variations in four intermediate variables: proportion married, postpartum infecundability, contraception and induced abortion. In another study Bongaarts argues that these four variables explain 96 per cent of the variation in fertility (Bongaarts 1985). The effects of delayed first sexual union, the effects of marital disruption, postpartum infecundability and abortion on fertility is such that the levels of fertility are reduced below those that would have prevailed in the absence of the effect of these proximate variables (Bongaarts, Frank and Lesthaeghe 1984). Differentials and trends in fertility among populations over time can largely be explained by the variations in one or more of these variables (Bongaarts and Potter 1983).

In section 2.1.1 and section 2.1.2, the available literature is reviewed on the four proximate determinants, with particular attention paid to marriage, as it will be shown in Chapter 3 that the first wave of the NIDS survey did not include data on the other intermediate variables. These sections show that there has been a paradigm shift over the years in terms of the importance of each of the four intermediate determinants of fertility.

2.1.1 Marriage as a proximate determinant of fertility

The proportion of women married or in sexual unions measures the degree to which women of reproductive age are exposed to the risk of conceiving (Bongaarts, Frank and Lesthaeghe 1984). However, in all societies, childbearing is socially approved if it occurs to women who are in a stable sexual union. Age at first marriage identifies the onset of exposure to the risk of socially-sanctioned childbearing and is a principle determinant of the number of births a woman will have (Bongaarts and Potter 1983). Thus time spent in sexual unions for all women of childbearing age is largely dependent on age at first marriage, the proportion of women who never marry, the frequency of remarriage for women who get divorced or widowed and the age at which sexual activity comes to an end if the woman has not reached menopause (Bongaarts, Frank and Lesthaeghe 1984).

In a study of fertility determinants in sub-Saharan Africa, Bongaarts, Frank and Lesthaeghe (1984) show that the average age at first marriage varies regionally from below 17 years to around 22. The differentials in age at first marriage reflect regional and ethnic practices rather than a continental transition in age at first marriage (Bongaarts, Frank and Lesthaeghe 1984). Warren, Johnson, Gule *et al* (1992) echo the view that marriage patterns and practices are different in Africa due to cultural practices. They observe that in Swaziland it is difficult to determine whether a woman is married and when she was married (if she is married) as marriage is a long process with several stages which do not form a defined pattern. Hence it is difficult to determine the age at first marriage. Using the Bongaarts model of proximate determinants of fertility, they found that the effect of marriage on fertility is moderate (Warren, Johnson, Gule *et al.* 1992). They also observed that there was no indication that marriage patterns are changing rapidly, or that they could be affected by government intervention.

In another study using DHS data from nine countries in southern and eastern Africa it has been observed that age at first marriage has been rising (Harwood-Lejeune 2001). The rise in age at first marriage has contributed to a decline in fertility in these countries. Harwood-Lejeune (2001) estimates that one-sixth to one third of fertility declines are due to rising age at first marriage.

Table 2.1: Median ages at first marriage and first birth, percentage of premarital first births

	Median age at first marriage	Median age at first birth	Interval between median ages at first marriage and first birth	Percentage of births which are premarital
Uganda (1995)	17.75	18.83	1.08	20.00
Mozambique (1997)	17.75	19.17	1.42	19.00
Malawi (1992)	17.92	19.00	1.08	13.00
Zambia (1996)	18.08	18.75	0.67	22.00
Tanzania (1991-92)	18.08	19.00	0.92	21.00
Tanzania (1996)	18.58	19.33	0.75	21.00
Madagascar (1997)	18.75	19.50	0.75	23.00
Zimbabwe (1994)	19.33	19.75	0.42	24.00
Kenya (1998)	19.67	19.75	0.08	32.00
Namibia (1992)	24.42	20.75	–3.67	56.00

Source: Harwood-Lejeune (2001)

It has been noted that exposure to childbearing outside marriage is considerable in Africa (Bongaarts, Frank and Lesthaeghe 1984; Kirk and Pillet 1998). This is due to significant premarital and extramarital sexuality together with marriage instability (Bongaarts, Frank and Lesthaeghe 1984; Harwood-Lejeune 2001). It can be observed from Table 2.1 that there is a considerable amount of childbearing happening before first marriage. In most countries, more than one in every five births has occurred before the mother's first marriage. To add to this, the interval between the median age at first birth and median age at first marriage has been noted to be equal to or less than 0.75 of a year in a number of countries. This supports the assertion that childbearing outside marriage is significant in Africa and that premarital sexual activity is substantial. This implies that age at first marriage is not a good indicator of the onset of exposure to the risk of childbearing. One striking feature of the relationship between age at first marriage, age at first birth and proportion of premarital births as observed by Harwood-Lejeune (2001) is that both age at first birth and age at first marriage is higher in countries with an established fertility decline than in countries with no evidence of a fertility decline, and that premarital childbearing is also higher in countries with an established fertility decline than in countries with no evidence of a fertility decline.

The relationship between age at first marriage and the stage at which a country is in the fertility transition may signal an erosion of ethnic values and practices that brought about regional variations in age at first marriage, as observed by Bongaarts, Frank and Lesthaeghe (1984). This implies that as a country's fertility transition becomes more advanced, variations between age at first marriage will not necessarily be due to cultural values and practices but by changes in other conditions which affect them. Thus, the level of the effect of age at first birth on the number of children a

woman of childbearing age will have may also change as factors affecting it have changed.

Bongaarts, Frank and Lesthaeghe (1984) note that marital instability due to divorce or widowhood is high throughout sub-Saharan Africa by any standards. However, they claim that women in sub-Saharan Africa will spend over 90 per cent of their reproductive life in a union. This, according to them, is due to the higher rate of remarriage after the first or subsequent dissolution of marriage. As a result of this there are few women who will be currently divorced or widowed at any time. This implies that the inhibiting effect of divorce or widowhood on fertility might be small.

2.1.2 Other proximate determinants of fertility

Apart from the proportion of married women, it has also been noted that post-partum infecundability, abortion and contraception are the other proximate determinants of fertility. Kirk and Pillet (1998) note that data on abortion are scanty. This might be due to the illegality of abortion in many sub-Saharan African countries. However, they note that though it is illegal in many countries, its prevalence is likely to be higher in countries where traditional and less efficient methods of contraception are used.

Bongaarts and Potter (1983) demonstrated that the principle determinants of African natural fertility during the early stages of the demographic transition were marriage and duration and intensity of breastfeeding. However, it has been observed that during the transition from high to low fertility, a rise in the practice of contraception is the only principle proximate determinant of fertility decline (Bongaarts 1987). This is supported by Kirk and Pillet (1998) who note that the differences in total fertility rates between sub-Saharan African countries with an advanced fertility transition and those with no evidence of a transition is mainly due to contraception. The rise in the practice of contraception makes the effects of the variation in marriage patterns and breastfeeding modest. This is because couples have the means to adjust fertility to the desired levels (Bongaarts 1987).

In a study of sub-national variations in the proximate determinants by Singh, Casterline and Cleland (1985), it was found that changes in marriage patterns and contraceptive use almost counterbalances the impact of duration of post-partum infecundability on fertility. They observed that declines in breastfeeding in countries where marriages were almost universal and contraceptive use was low contributed to an increase in fertility, while in other countries the declines in breastfeeding did not lead to an increase in fertility as it was counterbalanced by changes in contraception use and

marriage patterns. Furthermore, the contributions of marriage patterns and contraception use tended to be in the same direction while that of breastfeeding through post-partum infecundability tended to be in the opposite direction and was smaller (Singh, Casterline and Cleland 1985).

Data from the 1988 Swaziland Family Health Survey (FHS) show that post-partum infecundability is the most important proximate determinant of fertility (Warren, Johnson, Gule *et al.* 1992). However, there is also evidence that contraceptive use is the most likely variable that will bring about fertility decline in Swaziland. Kirk and Pillet (1998) also note that the inhibiting effect of contraception has begun to increase only recently as post-partum infecundability was the major component of child spacing and fertility regulation in sub-Saharan Africa.

A study of trends in proximate determinants of fertility in Kenya and Zimbabwe show that in Zimbabwe, the inhibiting effect of contraception is more important than the effects of marriage patterns and post-partum infecundability, and that contraception has the greatest suppressing effects in younger and middle aged women, while in Kenya contraception comes second after post-partum infecundability (Sibanda 1999).

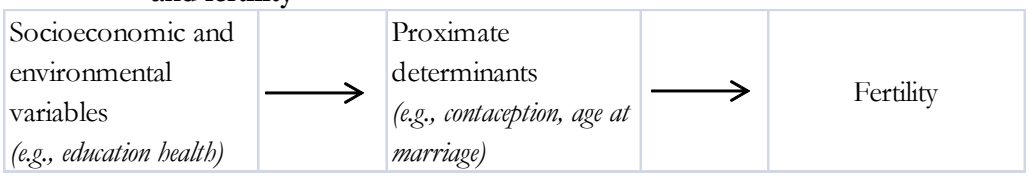
Section 2.1 looked at the proximate determinants of fertility. It has been shown that over time and as countries move into the different stages of the fertility transition, the importance of each of the four proximate determinants has changed in terms of how much it affects fertility. Age at first marriage and post-partum infecundability are the principle proximate determinants at the onset of a fertility transition; however, as the transition progresses contraception has taken over as the principle determinant. The unavailability of abortion data in most demographic surveys has made it difficult to study further the effect of abortion. Restrictive abortion laws have restricted researchers on the type and quality of abortion data that can be collected.

2.2 Socio-economic variables affecting fertility

It is a requirement that analysis of factors influencing fertility should define the distinction between proximate determinants and socioeconomic and environmental factors affecting fertility (Bongaarts, Frank and Lesthaeghe 1984). The former consist of variables identified in section 2.1 while the latter include social, cultural, economic and environmental factors that will be explored in this section. Figure 2.1 presents the link of how the two groups of factors affect fertility. In contrast to proximate determinants,

socioeconomic and environmental factors indirectly affect fertility by altering proximate determinants.

Figure 2.1: Relationship between socio-economic variables, proximate determinants and fertility



Source: Bongaarts, Frank and Lesthaeghe (1984)

The net effect of socioeconomic and environmental factors on fertility can be positive, negative or insignificant depending on their relative effects on the proximate determinants (Bongaarts, Frank and Lesthaeghe 1984). In the ensuing paragraphs, we expound on the socioeconomic factors affecting fertility. We pay particular attention to factors that we are interested in for this study namely; education, employment, urban residence, income and expenditure.

The plan of action for the 1994 Cairo International Conference on Population and Development (ICPD), which seeks to reduce population growth and improve livelihoods, called on governments to raise the status of women as a prerequisite for reducing birth rates (Kirk 1996). It also called for the improvement in education and child health as necessary for reducing fertility. However, Kirk argues that of the three it is education that has the most significant effects on fertility. Several studies have identified education as having an indirect effect on fertility (Cochrane 1979; Caldwell 1980; Kravdal 2001). Caldwell (1980) notes that education affects fertility through the restructuring of family relationships, and hence family economies and the direction of wealth flow. It is known that there is an inverse relationship between education and fertility. Cochrane (1979) notes that other things being equal, education affects the proximate determinants of fertility through its influence on the proportion married, age at first marriage and through its relation with attitudes that favour birth control, improved knowledge of birth control and better communication between husband and wife. Not only does education affect marriage patterns and contraceptive use, it also affects post-partum infecundability as educated women replace breastfeeding earlier with alternative milk or solid foods and are more likely to reduce duration of post-partum abstinence (Bongaarts, Frank and Lesthaeghe 1984).

Kravdal (2002) notes that weaker childbearing desires among educated women are attributed to, among other things, fertility inhibiting effects, such as higher opportunity costs, unavailability of children for domestic and agricultural work as a result of the child's own education, and less dependency on children for old age-security. He continues to state that through social learning and social influence, a woman's fertility might be altered by the education of others. However, the effects of education of others are slightly more marked among educated women (Kravdal 2002).

In Zimbabwe, a system of community-based distributors of family planning services was associated with higher adoption of contraception among better educated women, whereas improved quality of the distributors benefited the least educated women (Ainsworth 1996). Kravdal (2001) reports that in Tanzania, giving a woman more education reduces her fertility. He notes that there is a slight increase in age at first birth but there is no significant difference on higher order birth rates if a woman only attains primary education. On the other hand, secondary education affects fertility more as age at first birth is pushed much further. In Ado-Ekiti district of southwest Nigeria, the decline in the mean duration of post-partum abstinence was due to education (Caldwell, Orubuloye and Caldwell 1992).

2.3 Fertility and socio-economic factors in South Africa

The political climate surrounding fertility dynamics during apartheid South Africa is important in understanding the fertility decline in South Africa. Central to that climate were policies that advocated for social and economic disparities amongst South Africans of different races (Moultrie and Timaeus 2003; Kaufman 2000). Racial classification was central to service delivery and categorisation of social class amongst the people. As much as race is not a proximate determinant of fertility others have billed it as being one of the factors explaining differentials in fertility in South Africa (Sibanda and Zuberi 2005). This section reviews the literature on fertility in South Africa. It pays attention to factors affecting fertility and begins by looking at levels and trends in fertility in South Africa while paying attention to racial differentials.

2.3.1 Fertility in South Africa

Levels of fertility in South Africa have not been equal across population groups and within population groups over time (Kaufman 2000; Chimere-Dan 1993). Fertility in South Africa started falling way before most countries in sub-Saharan Africa and is the lowest in the region (Moultrie and Timaeus 2003; Caldwell and Caldwell 1993). As can be seen from Table 2.2 fertility levels have been different between population groups at

any given point in time. In general, African women have had the highest levels while White women have had the lowest levels. Fertility has been falling for women of all population groups.

Estimates from Udjo (2003) show that between 1970 and 1995, the Total Fertility Rate (TFR) fell from 4.9 children to 3.2 children for all women. In the same period the TFR fell from 5.4 to 3.6 children for African women and from 3.1 to 2.0 children for White women. There were also huge declines of fertility for Coloured women from 5.1 to 2.8 children while the TFR had fallen from 4.1 to 2.5 children for Asian women.

Moultrie and Timaeus (2003) used the 1996 census to estimate levels of fertility. Their estimates of fertility in 1996 were almost the same as those produced by Udjo (2003) for 1995. Direct estimates from the 1998 South African Demographic and Health Survey show that African women had the highest fertility while White women had the lowest (Department of Health 2002). On the other hand, Moultrie and Dorrington (2004) used the 2001 census data and found that the TFR had declined in all population groups when compared to the 1996 census data.

Table 2.2: Estimates of Total Fertility Rates (TFRs), South Africa 1970-2001

			Estimates				
Author and year of publication	Data	Year(s) to which estimates apply	African	Coloured	Asian	White	All
Udjo (2003)	1996 Census	1970	5.4	5.1	4.1	3.1	4.9
Udjo (2003)	1996 Census	1975	5.1	4.2	3.7	2.8	4.6
Udjo (2003)	1996 Census	1980	4.7	3.2	3.2	2.5	4.3
Udjo (2003)	1996 Census	1985	4.1	3.2	2.7	2.2	3.5
Udjo (2003)	1996 Census	1990	3.9	2.9	2.9	2.1	3.3
Udjo (2003)	1996 Census	1995	3.6	2.8	2.5	2.0	3.2
Department of Health (2002)	1998 DHS	1996-1998	3.1	2.5		1.9	2.9
Moultrie and Timaeus (2003)	1996 Census	1996	3.5	2.6	2.5	2.0	3.2
Moultrie and Dorrington (2004)	2001 Census	2001	3.0	2.4	2.0	1.8	2.8

Note: Direct estimate of TFR from Department of Health for Asian women not available as sample was too small

Even though the estimates presented above have been produced using different methods, and mostly from different data sources, there is a general consensus that fertility levels are not the same amongst population groups and that they are highest amongst African women and lowest amongst White women. Fertility rates among White and Asian women are now below replacement level.

2.3.2 Factors affecting fertility in South Africa

It is clear from the discussion above that fertility levels follow clear patterns of racial stratification. However, it has been observed that the patterns of racial stratification of fertility levels did not entirely originate from the implementation of apartheid policies (Chimere-Dan 1993). The current levels of fertility have been attributed to the levels of the uptake of contraception which during the apartheid period were central to the state sponsored family planning programme (Chimere-Dan 1993; Kaufman 1998; 2000). Apart from contraceptives, there are several factors that have been described as having effects on fertility that have favoured the current levels.

One of the factors that has been heavily associated with fertility decline in South Africa is education (Thomas 1999; Sibanda and Zuberi 2005). Using data from the Project for Statistics on Living Standards and Development (PSLSD), Thomas found that there is a strong association between education and children ever born to African women such that a year increase in education leads to 0.12 fewer children. He also observed that amongst Coloured women the effects of education on children ever born were almost the same as those of African women. The effects were half as large for Indians and relatively small for White women (Thomas 1999). Using data from the 1996 population census, Sibanda and Zuberi (2005) observed that women with secondary and postsecondary education had lower odds of becoming mothers at any given age between 17 and 32. They observed that women with postsecondary education had less than a third of the odds of women with no education of having a first birth below age 24. Thomas (1999) observed that if more African women passed Junior Certificate or Matric, fertility decline would be more rapid.

An examination of marital patterns is also important in explaining differentials in fertility levels. It has been noted that as South Africa was going through dramatic social, political and economic changes, there were also changes relating to marital patterns (Zwang and Garenne 2008). Some of the changes include late entry into marriage by women, high proportions of women who never marry and an emergence of premarital fertility (Zwang and Garenne 2008; Garenne, Tollman, Kahn *et al.* 2001). Zwang and Garenne (2008) state that in South Africa, high frequency of premarital fertility is a feature of the African and Coloured races, and is found in both urban and rural areas. However, it is difficult to firmly state that pre-marital fertility is a recent phenomenon as noted above. In African societies, it was a tradition that premarital pregnancy/childbearing would lead in most cases to marriage as premarital intercourse was rare (Zwang and Garenne 2008). As such, one would wonder whether pre-marital

fertility is a recent phenomenon or not. What might have changed might be the attitude of people towards pre-marital fertility rather than premarital fertility itself.

Udjo (2001) has noted that marital patterns have contributed to the decline in South African fertility. Using the 1996 South African census data he found that marriage is almost universal among Asians and Whites and that a substantial proportion of Africans and Coloureds never marry. He also found that age at first marriage for South African women is high and is highest among African women and lowest among Asian and White women. However, due to cultural variations in the definition of marriage, it is possible that the value of age at first marriage amongst African women is biased upwards as most marriage is process and therefore difficult to tell when exactly a person got married. Nonetheless, he concludes that the reduction in the total fertility rate attributable to marital patterns was much higher among Africans and Coloureds than among Asians and Whites.

In assessing the trajectory and patterns of fertility in South Africa, Moultrie and Dorrington (2004) found that although teenage fertility seems to have fallen in absolute terms, the rates are still high, especially for African and Coloured women. Garenne, Tollman, Kahn *et al* (2001) have attributed high premarital fertility to the increasing age at first marriage. However, Moultrie and McGrath (2007) note that even though premarital fertility is high, it has been falling. Using different data sets (African Centre for Health and Population Studies – Demographic Surveillance Site in KwaZulu-Natal, national antenatal clinic prevalence surveys, 1998 South Africa Demographic and Health Survey and 1996 and 2001 census data) Moultrie and McGrath show that between 1995 and 2005, premarital fertility has been falling in South Africa. They argue that over the period 1990 and 2005 during which the DSS data was collected, the proportion of young adults in KwaZulu-Natal who have ever had sex remained stable and that current use of contraception rose significantly between 2000 and 2005. This might offer insights to what has led to the decline in premarital fertility, although other factors like abortion cannot be ruled out. Garenne, Tollman, Kahn *et al.* (2001) note that the high prevalence of adolescent fertility, which is mostly premarital, will have a strong effect on age specific rates and on the shape of the fertility schedule. And since pre-marital fertility is a feature of the African and Coloured races, then differentials in the levels fertility and in the fertility schedules will continue to persist.

Household and community resources have also been associated with fertility in South Africa. Thomas (1999) concludes that income significantly depresses childbearing

even though the magnitude of the effect of household resources on fertility cannot be precisely measured. His results also point out that education of the spouse has an effect on fertility. Another factor documented as having an effect on fertility is place of residence. Early childbearing in South Africa is associated urban residence (Sibanda and Zuberi 2005). Among African women below the age of 22, the effects of urban residence on the timing of first birth are positive below.

This chapter has reviewed the available literature in relation to fertility with particular reference to; - proximate determinants of fertility; relationship between determinants of fertility and socio-economic factors; and a review of fertility in South Africa. As much as race is not a proximate determinant of fertility, it is important in the presentation of demographic data to show differentials between different population groups. However, it has also been presented by other researchers as having an effect on fertility. Although much of their results depict it as being important in explaining fertility levels, we note that there are other background factors that introduce differences in fertility between population groups. Unless one controls for such factors the chances are that race will continue to be depicted as having an effect on fertility.

3 DATA

This chapter introduces the sources of data used and investigates the distribution of people interviewed in the first wave of the NIDS survey. We examine the consistency of the data by looking at the variables used in this study. We also compare the NIDS data with data from the 2007 Community Survey to check for consistencies as to how the questions were answered in the NIDS survey and check for the adequacy of the NIDS data. Unless otherwise stated, all data from the 2007 Community Survey have been obtained from the Stats SA website (www.statssa.gov.za).

3.1 Data source

The study uses data from the first wave of the National Income Dynamics Study (NIDS) obtained from University of Cape Town's Datafirst online database (www.datafirst.uct.ac.za). NIDS is a panel study that came about as part of the South African presidency initiative to track changes in the well-being of about 28,000 South Africans over a period of years (Leibbrandt, Woolard and de Villiers 2009). Questions were designed to solicit information on: wealth creation in terms of income and expenditure; demographic dynamics; social heritage including education and employment dynamics; and access to cash transfers and social services.

The first wave was conducted using a stratified, two-stage sample design selecting 400 Primary sampling Units (PSUs) from Stats SA's Master sample of 3000 PSUs (Leibbrandt, Woolard and de Villiers 2009). The target population were primary households and residents in workers' hostels, convents and monasteries in all provinces but excluded living quarters such as students' hostels and prisons. Data for 31,170 individuals from 7305 households was captured and of these, 28,225 individuals were resident members of the household. The strata in the sample were the district councils and the PSUs were randomly selected from the strata.

The sample design was not representative at provincial level and to correct for this problem, two weights (design weights and post-stratification weights) were derived in two stages (Wittenberg 2009). Design weights were calculated to correct for probability of non-inclusion of PSU and household non-response. Post-stratification weights were derived to make sure that the NIDS population age-sex-race distributions conform to the 2008 midyear population estimates as published by Stats SA. In the calculation of the post-stratified weights, another constraint imposed was that the

provincial population and the total weights should sum up to the total 2008 midyear population as published by Stats SA (Wittenberg 2009).

The NIDS study collected individual and household level information. Questions were asked to women of reproductive age on their birth histories. The questions closely followed the format in Demographic and Health Surveys (Moultrie and Dorrington 2009). These allow for direct estimation of fertility rates. Questions were also asked on individual and household income. The measurement of income focused on the last 30 days prior to the survey so as to reduce the impact of recall errors. From these questions an aggregate best income was calculated to give a better picture of income. Survey literature show that aggregate income calculated from different kinds of questions is better when compared to income from a "one-shot" question as it takes into consideration different forms of sources of income (Argent 2009).

Data on the proximate determinants of fertility were not comprehensively collected in the NIDS survey. There was a question on current marital status. However, there was no follow up question to this one as to when the woman got married and if she has ever been married before for those that were currently married. There was no data collected on contraception, abortion as well as data on breastfeeding and post-partum sexual abstinence.

3.2 Data quality

This section investigates the consistency of the data as a measure of quality. We begin by looking at the sex distribution for all people in the NIDS survey. Table 3.1 shows that there are only 11 (0.04 per cent) people whose sex is missing. Since we have few people whose sex is not known, we might as well assume that omitting them cannot greatly affect our results.

Table 3.1 Sex distribution of NIDS survey participants (weighted)

Sex	Freq.	Per cent
Male	13,629	48.24
Female	14,613	51.72
Missing	11	0.04
Total	28,253	100

Table 3.2 shows the list of key variables included in this study and their distribution. These include a dummy variable on whether a woman has ever given birth, the number of children ever born to a woman, age, marital status, race, education, area of residence, employment status, poverty status and household income. Other measures

of income will be introduced later. We pay specific attention to variables with missing values as further examination of the variables will be done in later sections.

The poverty status variable is an indicator variable showing whether a person is below or above the poverty line. It came in the database and was derived following Hoovegeen and Ozler (2005), as explained by Argent, Finn, Leibbrandt and Woolard (2009). A household was classified as poor if per capita income was below the lower poverty line of R502 per month.

From the table it can be seen that only 4 women did not say whether they have ever had a child or not, which represents less than 1 per cent of the sample. There were 5 women who did not disclose the number of children they have ever given birth to, representing less than 1 per cent. Less than 1 per cent (17) of the women did not give information on their marital status. Information was also sought on women's highest education and employment status. On education, less than 1 per cent (7) of the women did not give out information while on employment status, 59 women (less than 1 per cent) did not give out their information.

Table 3.2 Descriptive statistics for women 15-49 (unweighted)

Variable	Freq.	Per cent
Ever given birth		
No	1,935	29.06
Yes	4,719	70.88
Missing	4	0.06
Children ever born		
mean	1.796332	
Standard deviation	1.828033	
Missing	5	0.06
Age		
15-19	1,383	20.77
20-24	1,240	18.62
25-29	899	13.50
30-34	808	12.14
35-39	835	12.54
40-44	767	11.52
45-49	726	10.90
Race		
African	5,331	80.07
Coloured	964	14.48
Asian	96	1.44
White	267	4.01
Marital Status		
Married	1,533	23.02
Living with partner	666	10.00
Widow/Widower	195	2.93
Divorced/Separated	147	2.21
Never Married	4,100	61.58
Missing	17	0.26
Education		
No education	379	5.69
Primary	1,307	19.63
Secondary	4,328	65.00
Higher	637	9.57
Missing	7	0.11
Area of residence		
urban	3,270	49.11
rural	3,388	50.89
Poverty Status		
Poor	4,209	63.22
Non-poor	2,449	36.78
Employment status		
Not economically active	2,536	38.09
Unemployed	1,776	26.67
Employed	2,287	34.35
Missing	59	0.89
Household income		
mean	4468.354	
Standard deviation	7476.813	
Total	6,658	100.00

3.2.1 Age distribution

We investigated the age distribution of all women in the study. Information on the respondent's age was collected using two questions. The first sought the respondent's age and the second sought their date of birth. From the date of birth question, a respondent's age was calculated and where there was an inconsistency between the two ages, the one from the date of birth was considered to be better. We used the age variable, w1_r_best_age_yrs which comes from the household roster data file and contains information for all people in the NIDS survey.

Age was calculated based on the respondent's date of birth by making use of a variety of logical checks. The first was to verify if the date of birth in the household roster was the same as the one in the individual data file then that date was used (Moultrie 2011, Personal Communication). If there was a mismatch between the two dates then the date from the individual file was used unless the one from the roster was more complete. To calculate age, the date of birth was subtracted from the date of interview. If the date of birth was missing then the first date of the month was used and if both date and month were missing then it was replaced with the first day of January (Moultrie 2011, Personal Communication).

Examination of the age variable for all female respondents show that only 16 people (0.02 per cent of all women) have their age missing as internally consistent ages could not be derived while 154 people (1.01 per cent) didn't know their age, and 3 women refused to give their ages. From Table 3.3 we can see that of those who didn't know their age, 119 (0.78 per cent of all females) were African, 12 (0.08 per cent) were Coloured, 6 were Asian (0.04 per cent), 9 (0.06 per cent) were White while 8 (0.05 per cent) were coded as those who were not supposed to answer the question on race. 48 of the 154 women who did not report their age reported to have ever given birth (0.3 per cent of all women), 2 said they had never given birth while 104 (0.68 per cent) were coded as those who were not supposed to answer the question.

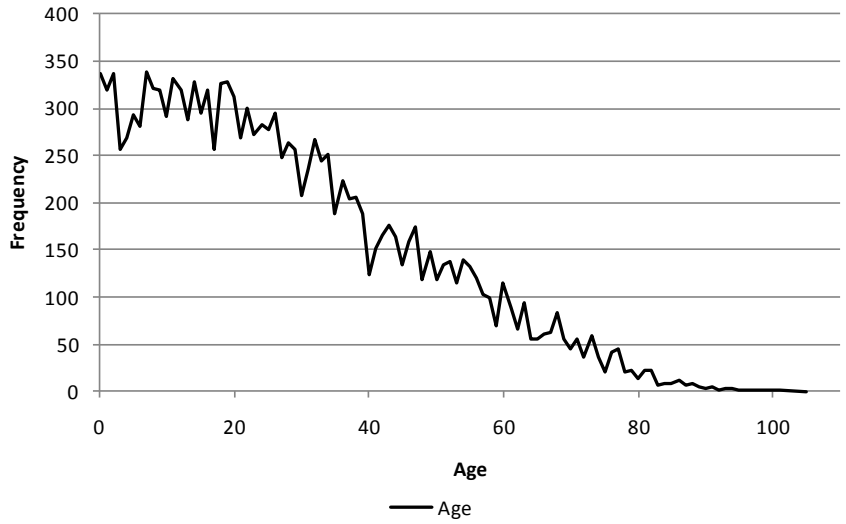
Table 3.3 Distribution of women whose age was not reported (weighted)

Variable			Freq.	Per cent of total
Age				
	Refused		3	0.02
	Missing		16	0.10
	Age not known			
		Race		
		African	119	0.78
		Coloured	12	0.08
		Asian	6	0.04
		White	9	0.06
		Not supposed to Answer	8	0.05
		Total Age not known by race	154	1.01
		Ever given Birth		
		Yes	48	0.31
		No	2	0.01
		Not supposed to Answer	104	0.68
		Total Age not known by ever given birth	154	1.01

Further examination of the age distribution (Figure 3.1) shows that age has been inconsistently reported. Although the distribution looks similar to a population pyramid distribution for South Africa, it shows problems that are faced in age reporting in most

developing countries. The trough between age 2 and 5 cannot be explained by the declining number of births two to five years before the survey. It indicates the omission of female children at these ages. There is also evidence of heaping on even ages but this might as well be due to the size of the sample being small. It should also be noted that the inconsistencies after age 60 could also be due to the small number of observations, but we might not rule out the effect of old age grants as people would misreport their age so that they can benefit from the grants.

Figure 3.1 Age distribution for all women



The age distribution of women aged 15-49 by population group shows that the distribution of African women by age is not smooth (Figure 3.2). This suggests the presence of age misreporting among African women. It is difficult to comment on the distributions of Coloured, Asian and White women from the figure as trends cannot be easily identified since they have been outnumbered by their African counterparts. Figure 3.3 shows the age distribution of Coloured, Asian and White women. The figure shows that the age distributions of these women are irregular. They have been affected by the small sample size as such one cannot get a smooth curve.

Figure 3.2 Age distribution of women 15-49 by race

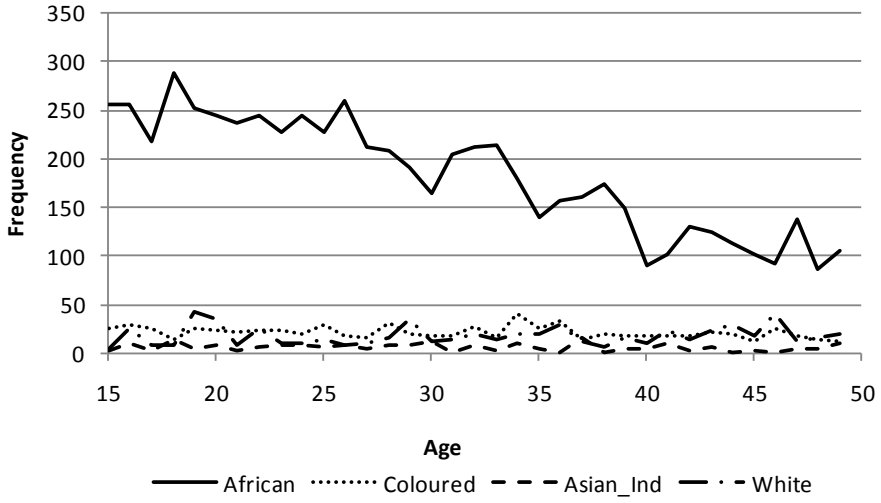
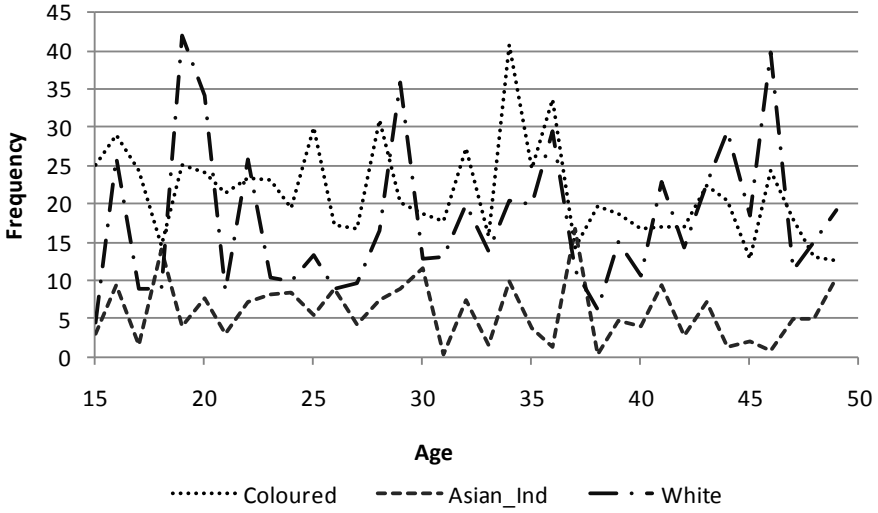
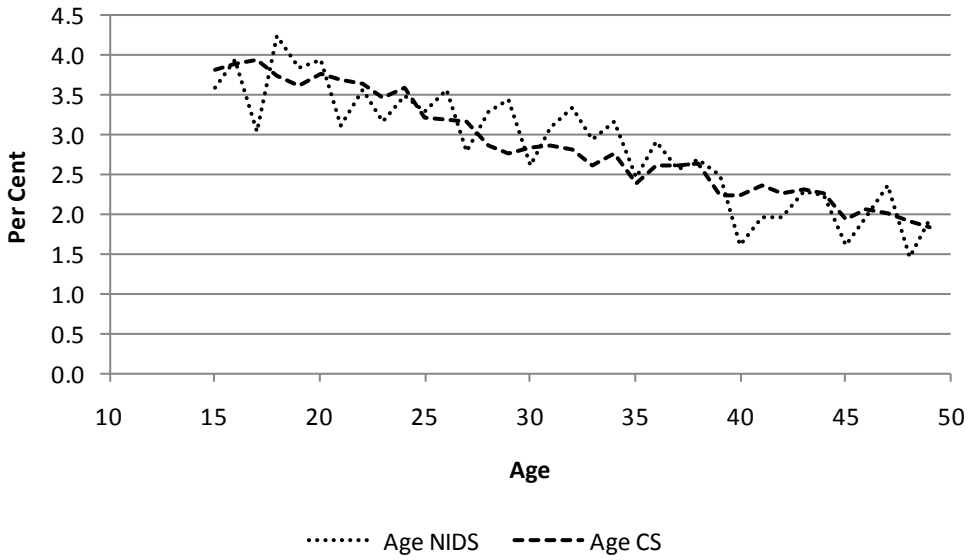


Figure 3.3 Age distribution of Coloured, Asian and White women 15-49



The distribution of women aged 15-49 in the NIDS data are compared with women 15-49 in the 2007 Community Survey (CS). Figure 3.4 shows the percentage age distribution of women 15-49 in the two surveys. Bearing in mind that data collection in the NIDS survey took place a year after the community survey, one would not expect the patterns of the two surveys depicted in Figure 3.4 to be different. Although the graphs show variability in age, the lack of fit between the two graphs might be as a result of the differences in sample size. It can be observed that the Community Survey graph tracks the mid-point of the NIDS study well. Given that the sample size in the NIDS study is smaller compared to that in the Community Survey, the age distribution in the NIDS study is not bad.

Figure 3.4 Percentage Distribution of women 15-49 in NIDS survey and 2007 Community Survey by age

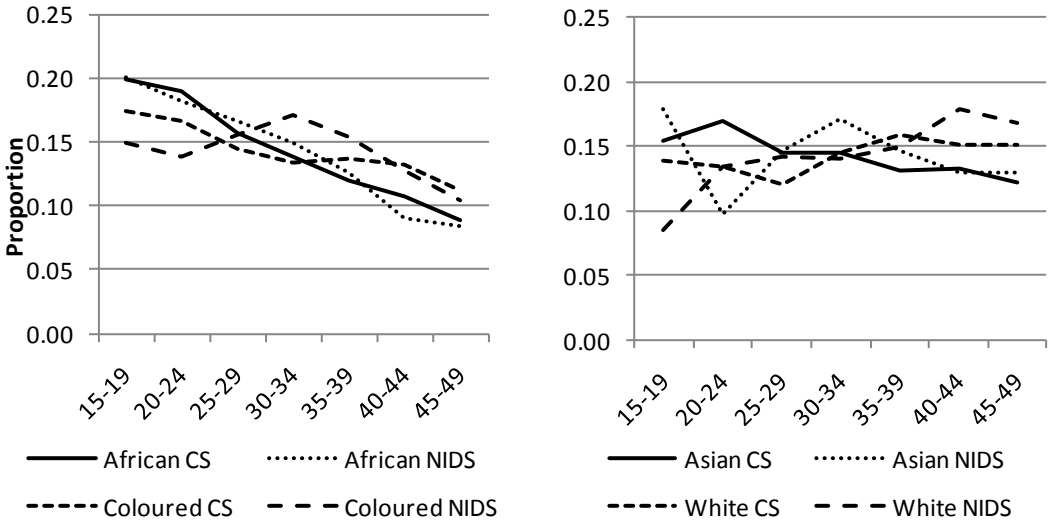


3.2.2 Racial and provincial distribution: NIDS vs. 2007 Community Survey

Figure 3.5 shows the distribution of women by age and population group between the NIDS survey and the 2007 Community Survey. Given the small time interval between the two surveys and that the graphs are shown with respect to age, we would not expect very marked differences in the distributions of the graphs by population group.

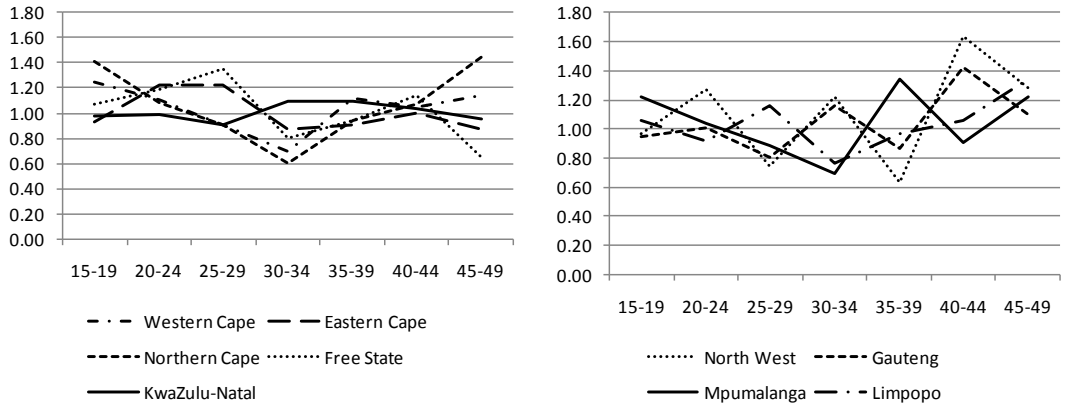
The figure shows that difference in the proportion of African women of child-bearing age by age group is not very different in the two surveys. However, the picture is not good when one compares the distribution of Coloured women between the two surveys. It gets worse when comparing Asian and White women between the two surveys. Thus the data are much better for African women than for women of other population groups. This implies therefore that in analysing inter-population group differentials, one is better off analysing data for Africans alone as data for the other population groups are insufficient to give reliable results.

Figure 3.5 Proportional distribution of women by age and race: NIDS vs. 2007 Community Survey



The distributions of provincial population between two points in time are affected by migration and natural increase. As the time period increases, the proportional effect of migration increases while that of natural increase decreases when compared to the gross effect. Figure 3.6 shows the ratios of the distribution of women in each province by age group in the Community Survey to that in the NIDS survey. The figure shows that the distributions for each province are different between the two surveys. The ratios for each province show a great degree of movement in the working age groups. For all provinces save for KwaZulu Natal (KZN), the proportions of women are not close between the two surveys. The closeness between the proportions at all ages in the two surveys in KZN might be due to the fact that about 20 per cent of all women of childbearing age were from KZN. Thus the smaller sample in the other regions means that their proportions might not be similar to those in the Community Survey. This also implies that analysing inter-province variability for the other provinces might produce unreliable results.

Figure 3.6 Provincial distributions of women, ratios: Community Survey: NIDS



3.2.3 Fertility measures (children ever born and whether a woman has ever given birth)

All women of childbearing age were asked if they had ever given birth. From this question we got the first measure of fertility, which was used in this study (that is, whether a woman has ever given birth or not).

If a woman had ever given birth, she was asked about the number of children who were alive and living with her, the number of children alive but living elsewhere and the number of children dead. From these three questions, the second fertility measure, the number of children ever born, was derived.

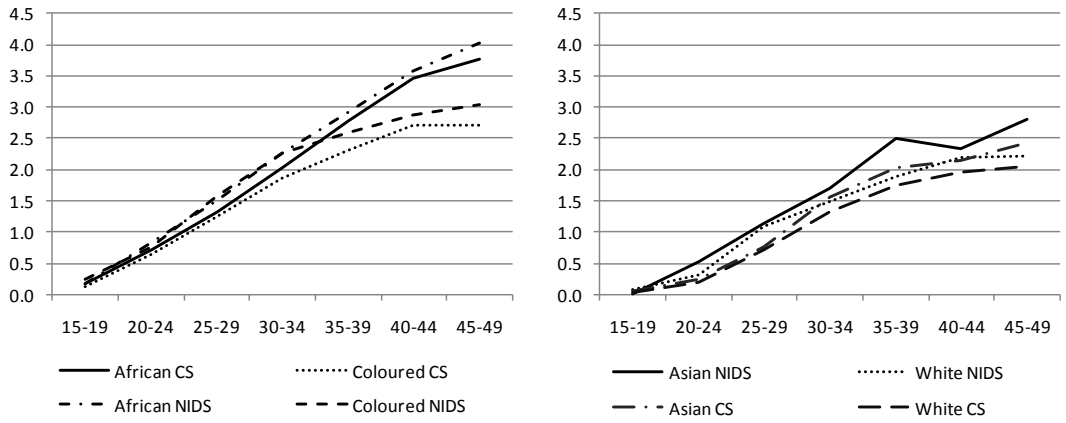
Table 3.4 shows the proportion of childless women and parities by age group and population group. The table shows that for each population group, about one quarter of all women has never given birth. It also shows that fewer women remain childless by the time they complete childbearing, regardless of their population group. The proportion of childless women suggests that more than 95 per cent of White women are yet to start childbearing by their 20th birthday and more than half of African, Coloured and Indian women start childbearing before their 25th birthday. The table shows that the sample size for Asian women aged 35-39 and 45-49 was too small. Similar observations are made for Coloured and White women. With the sample for Asian, Coloured and White women being smaller, there are even fewer women aged 35 and above, which means that proportions of childless women in the last three age groups will be affected by the small sample size. Overall, the distribution of childless women by age is more regular for African women than it is for women of other population groups.

Table 3.4 Distribution of average parities and proportion childless by age and race

Age group	African Propn. Childless	Avg. Parity	Coloured Propn. childless	Avg. parity	Asian Propn. childless	Avg. parity	White Propn. childless	Avg. parity
15-19	0.8464	0.1738	0.7844	0.2372	1.0000	0.0000	0.9634	0.0833
20-24	0.4073	0.8293	0.4895	0.7682	0.4477	0.5333	0.6182	0.3143
25-29	0.1783	1.5235	0.1910	1.5772	0.0816	1.1429	0.2979	1.0833
30-34	0.0909	2.2559	0.1689	2.2698	0.1096	1.6923	0.2057	1.5000
35-39	0.0462	2.9244	0.0269	2.5948	0.0000	2.5000	0.0808	1.8936
40-44	0.0234	3.5744	0.0418	2.8833	0.0112	2.3333	0.0402	2.1875
45-49	0.0261	4.0285	0.0098	3.0448	0.0000	2.8000	0.0619	2.2075
Total	0.2972	1.8091	0.2540	1.8525	0.2537	1.5104	0.2664	1.5131

We also compare average parities for women by population group from NIDS and Community Survey (Figure 3.7). The figure shows that average parities for African women are similar in the two surveys although the NIDS survey suggests there are more women of higher parities for the age groups 25-29, 30-34 and 45-49. Average parities for women of other population groups appear to be higher in the NIDS study for all population groups at all ages except for the youngest age group. The differences in the average parities are largely due to smaller sample size of the NIDS study and hence the parity data for Coloured, Asian and White women are not reliable.

Figure 3.7 Average parities by age and race: NIDS vs. Community Survey (CS)[1]

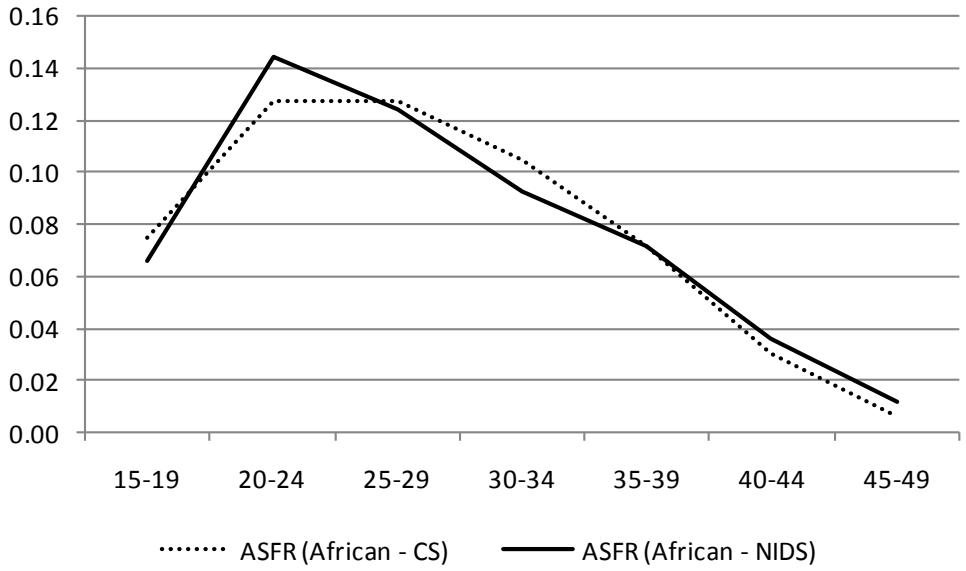


We also compare current fertility (Age Specific Fertility Rates – ASFR) for African women using data from their birth histories for the NIDS study and the Community Survey. We look at data for African women alone because as shown elsewhere, data for women of other population groups are very sparse and hence might not produce reliable results for the ASFR. Since the sample size is small and data are sparse, fertility rates are calculated based on births that occurred in the last three years. Figure 3.8 shows that when one considers the differences in the sample sizes, ASFRs for the two

[1] Community Survey data source: Moultrie T.A. (2011); Personal Communication

surveys are fairly consistent with each other except for women aged 20-24 and 30-34. Much as the ASFRs seem to be consistent, the shapes of the fertility schedules are slightly different. This has been exacerbated by the differences in the levels of fertility for women aged 20-24 and 30-34. The shape of the African fertility schedule in the NIDS data seems to be different from those of the 1998 DHS and 1996 census as presented by Moultrie and Timaeus (2003) and those of the 2001 census as presented by Moultrie and Dorrington (2004).

Figure 3.8 Age specific fertility rates for African Women: NIDS vs. Community Survey



Community Survey data source: Moultrie T.A. (2011); Personal Communication

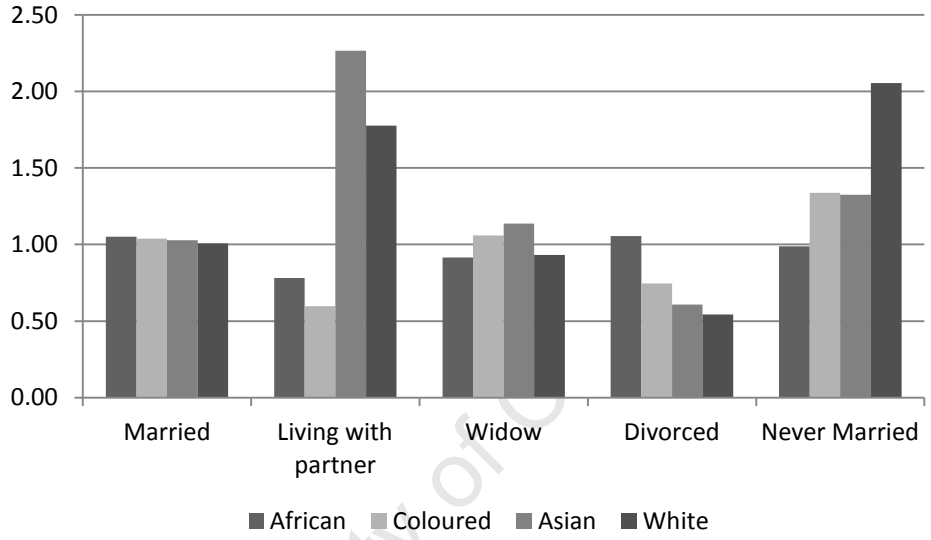
3.2.4 Marital status

Information was also sought on marital status from adult participants. As pointed out in section 3.2, less than 1 per cent of women of reproductive age had their marital status reportedly missing. From Table 3.2 it can be seen that 62 per cent of these women had never been married, 23 per cent were married, 10 per cent were living with a partner while just over 5 per cent were divorced, separated or widowed.

It would be ideal to compare the distribution of marital status of women of the reproductive age group with that in the Community Survey to see how the two surveys are consistent with each other. However, Stats SA has not released the unit record data on their website (www.statssa.gov.za) for women in this age group. However, they have provided marital status information for women aged 15 and above. This can still give a picture of how consistent the distribution of women 15-49 is, considering that the majority of women aged 15 and above are aged 15-49.

Figure 3.9 presents ratios of the distribution of women by marital status and population group in the community survey and the NIDS study. There is one data point for African women (for those living with partner) that show a difference in the two surveys, otherwise data for African women are consistent between the two surveys. Marital status data for women of other populations groups are not as reliable. With the exception of married and widowed categories, the data for the two surveys are not consistent.

Figure 3.9 Distribution of women 15 and above (ratios) by marital status and population group: NIDS vs. Community Survey



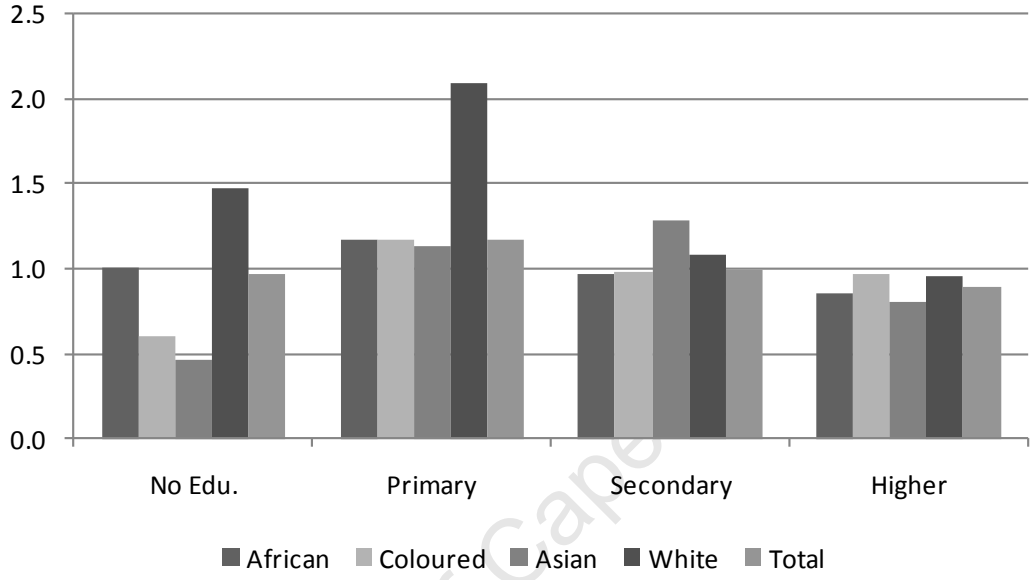
3.2.5 Education

The education variable has been coded into four categories (no education, primary education, secondary education and higher education). The category labelled higher was generated by combining those with post-secondary school certificates, diplomas and degrees. This was due to the smaller number of women with these qualifications. From Table 3.2 the majority of women had some secondary education (65 per cent) followed by women with primary education (20 per cent). Women with a post-secondary school certificate, a diploma and a degree comprised 10 per cent while those with no education comprised 6 per cent.

In Figure 3.10, the distributions of women aged 20 and above are compared in the NIDS survey and the Community Survey with regards to education. Data for women aged 20 and older are used because Community Survey unit data for education have not been released. The ratios in the figure show that, unlike for African women, education data are not reliable for women of other population groups. Considering that women of other population groups form about 20 per cent of the survey and that data for women

with no education, primary education, and women with either a post-secondary certificate, a diploma and a degree form about one third of the sample, the unreliability in the data might be largely due to smaller sample sizes rather than inaccuracies in reporting.

Figure 3.10 Distribution of women 15 and above (ratios) by education and population group: NIDS vs. Community Survey



3.2.6 Poverty measures: income and expenditure

As already stated, the measure of income used in this study was constructed from two sets of information; 'one shot' question from the household questionnaire asking total income after tax in the last month and individual level income questions across all sources (Argent 2009). If individual level income data were not significantly missing (not more than 40 per cent), an aggregate measure of household income was predicted and if fewer than 100 observations were missing, the missing values were set to be equal to the population median. If individual level information were significantly missing, the value given from the 'one shot' question was used and if this was missing as well, then income was set to be equal to zero (Argent 2009).

The questions focused on 30 days prior to the survey in order to reduce recall bias. Certain once-off types of income like payment of bride wealth, retirement gratuities and gifts were excluded. A few questions were asked about income in the last twelve months and these included the 13th cheque and profit shares, which were divided by twelve to get a monthly value (Argent 2009).

Table 3.5 shows descriptive statistics on household income for women in the reproductive age group. The table shows that there are disparities in terms of income

between and within population groups. The mean and median by population group suggest that African women have the lowest income compared to the other population groups. The standard deviations show that there are wider variations within the Asian and White population groups than in the African and Coloured population groups. The variation within the total population for women of the reproductive age group is also large with a standard deviation of R10603.39.

Table 3.5: Monthly household income for women aged 15-49 in Rands by population group (weighted): NIDS

Race	Mean R	Median R	Sd R
African	3799	2102	5584
Coloured	6622	4257	7583
Asian	18314	10472	18729
White	24501	16507	23713
Total	5907	2500	10603

The expenditure variable used in the study is logged per capita expenditure generated by taking the log of the sum of expenditure on food and expenditure on non-food stuff divided by household size (Finn, Franklin, Keswell *et al.* 2009). For the expenditure section in the NIDS survey, a list of 32 food items and 53 non-food items was compiled and household heads were asked if each item was consumed in the last month and, if so, the monetary value (Finn, Franklin, Keswell *et al.* 2009).

The value of the food item was decomposed into four: how much was actually spent; value of item if it was a gift; value received as payment; and the value of the item from own production. These four values were aggregated and imputations were performed to arrive at the aggregate consumption figure. As with the income data, the rule of thumb applied in the imputation procedure were the same; if more than 40 per cent of the cases had missing values then no imputations were done and that if there were less than 100 cases with missing values then the missing values were set to the population median.

Expenditure has been logged because just like income, it is skewed. When performing further analysis like regression, this tends to distort results as models are incorrectly specified. Table 3.6 presents descriptive statistics of the log of monthly expenditure by population group. As with income, there are also variations in terms of expenditure as suggested by the means and medians. The standard deviations suggest that variation in terms of expenditure within a population group is not large. However, this is the case because expenditure has been presented in logarithmic form rather than in the standard form. The logging has brought all observation closer such that there

seems to be less variation in expenditure. As with the income variable, we expect much more variation in expenditure within the population group.

Table 3.6: Log of monthly expenditure by population group (weighted): NIDS

Race	Mean	Median	Sd
African	5.8182	5.6937	1.0656
Coloured	6.5411	6.3201	1.1049
Asian	7.4393	7.6133	1.1692
White	8.0659	8.1051	0.9659
Total	6.0837	5.9017	1.2410

The other poverty measures considered in the study are the consumer durable score, housing and durables score and DHS-style wealth score. These are score variables generated by applying statistical techniques for data reduction and have been used in other studies where wealth data were not available or inadequate (Filmer and Pritchett 1999; 2001; Doctor and Simelane 2005).

The construction of such variables involves combining a number of variables and deriving weights such that the final score variable is weighted (Filmer and Pritchett 2001). A lower score indicates a lower standard of living while a higher score indicates a higher standard of living. Consumer durable score has been generated by combining variables that capture ownership of assets, such as a motor vehicle, telephone, fridge, hi-fi, video player, washing machine and micro-wave. For women of childbearing age, it ranges from approximately -1.48 to 17.49. The housing and durables score ranges from approximately -3.19 to 16.63. It is generated by combining the variables included in the consumer durable score and indicators of housing, such as availability of water supply, availability of electricity, toilet, and type of house. Due to multicolinearity, we do not include the housing and durables score in the regression analysis (chapter 4). The DHS-style wealth score is generated by combining indicators of availability of water supply, electricity, and a toilet and indicators of ownership of a radio, telephone, mobile phone, fridge, washing machine and a motor vehicle. It also takes into account expenditure on domestic help and land access. Involvement in farming has been used as an indicator to access to land. For women of childbearing ages, the score ranges from -3.6 to 15.25.

This chapter has attempted to examine the quality of the NIDS data. We have attempted to crosscheck the patterns with other data sets. In general, we have seen that the data are of fairly good quality to investigate the effects of race on fertility. There are some doubts with the quality of the age data and some inconsistencies with the Community Survey data, especially for race data. However, considering that the sample

size of the NIDS is small when compared to that of the Community survey, there is no doubt that the NIDS data can provide insights into the effects of race on fertility.

4 RESULTS

This chapter seeks to establish the effects of race on fertility controlling for other socio-economic factors on fertility. Two regression models were applied: logistic regression to investigate the effects of race on whether a woman has ever given birth or not; and linear regression to analyse the effects of race on the number of children that a woman has ever borne.

4.1 Logistic regression

Logistic regression models binary data resulting from a nonlinear relationship between the probability of observing an event, $p_i(x)$ and a set of covariates x_i (Agresti 2002). It does not require stringent model assumptions, especially those regarding linearity, normality and homoscedasticity. Since the logistic regression applies a non-linear log transformation of the predicted odds ratio, the relationship between the response and the independent variable does not need to be linear. The error terms (residuals) do not need to be normally distributed. However, normally distributed residuals yield more stable results.

The measure used is whether a woman has ever given birth or not as the response variable, taking the value of 1 if a woman has ever given birth and 0 if she has never given birth. Since it is binary in nature, its relationship with independent variables can be expressed as:

$$\text{logit}\,(p_i) = \log\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta_i x_i^{'}$$

where p_i is the probability that woman i has ever given birth with a set of explanatory variables $x_i^{'}$, and β_i is a vector of coefficients related to an explanatory variable x_i. The ratio $p_i \big/ 1-p_i$ is the odds ratio (OR) of a woman having ever given birth relative to never having given birth (also given as e^{β}).

An odds ratio shows whether the probability of success (π), is the same between two groups. It is a relative measure of the risk that tells us how much more likely a woman is to have ever given birth if she has been exposed to a set of factors (β_i) under study as compared to another woman who has not been exposed. They can reach any non-negative number. An odds ratio equal to 1 implies independence, in other words,

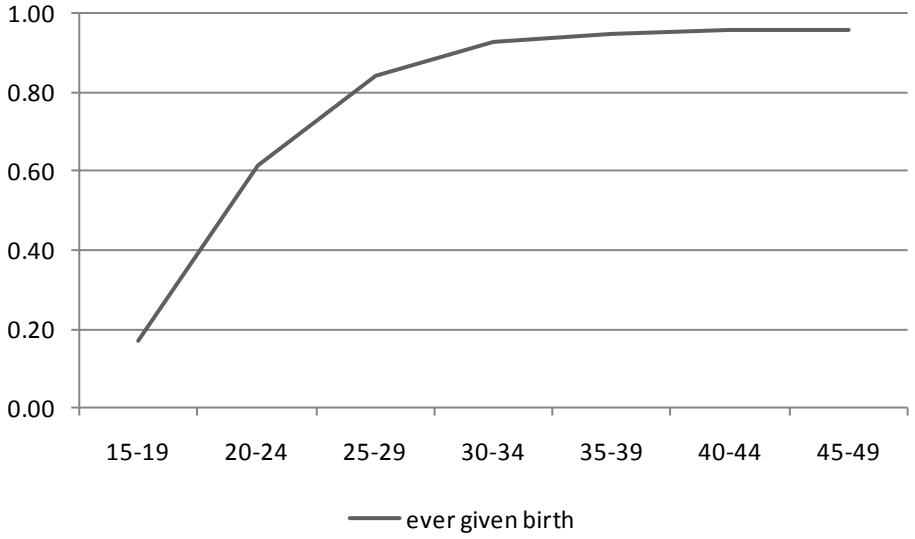
that an event is equally likely in both the exposed and the non-exposed group. An odds ratio greater than 1 implies that an event is more likely in the exposed category than in the non-exposed category while an odds of less than 1 implies that an event is less likely in the exposed category.

This study uses the variable w1_a_bhbrth (ever given birth) as a response variable for the logistic regression. The NIDS study asked women whether they have ever had a live birth. We have coded the indicators so that they take the value of 1 if a woman has ever had a child and 0 if she has never had a child.

The independent variables considered in the study for the response variable (ever given birth) include race, age, marital status, education, place of residence, employment status, measures of wealth status (poverty indicator, household income, household monthly expenditure, consumer durable score, housing and durables score and DHS-style wealth score). The major variable of interest is race, which has four categories (African, Coloured, Asian and White). The other variables are control variables. We consider different measures of wealth constructed differently so as to capture the effect of economic status and test whether race has an effect on whether a woman has ever given birth when we control for economic status.

The relationship between age and the response variable, ever given birth is not linear. Figure 4.1 shows that the response variable is a monotonic increasing function of age with a maximum of 1. The inclusion of age in the logistic regression model as it is might produce unreliable results. We have included another variable (age squared) to resolve this problem. As discussed in section 3.2.6, we have also logged household income and household expenditure so as to remove the distortion in these variables. The logged household income and household expenditure are normally distributed and therefore we expect better estimates of the coefficients.

Figure 4.1: Distribution of women who have ever given birth by age



4.2 Poisson regression

We consider a Poisson regression model to investigate the relation between race and fertility, specifically the number of children a woman has ever borne. A Poisson regression models count data for the response variable by assuming they take a Poisson distribution. A Poisson model is appropriate for modelling fertility when the measure of fertility is children ever born (Nguyen-Dinh 1997). It models the response variable as a non-negative integer and since the number of children ever born is non-negative, a Poisson model is appropriate. Rodriguez and Cleland (1988), have argued that due to the stochastic nature of birth counts, a Poisson model is appropriate as "it captures the empirical finding of larger variance at higher levels of fertility".

We generate the response variable, children ever born, by summing up answers from three questions: the number of children alive and living with the mother; number of children alive but living elsewhere; and number of children dead. Where we have a missing value for any of the three questions, then the number of children ever born will also be missing. Fortunately, we only have five cases where the number of children ever born is missing.

The independent variables considered for the response variable (children ever born) include race, marital status, education, place of residence, employment status, measures of wealth status (poverty status, household income, household monthly expenditure, consumer durable score, housing and durables score and DHS-style wealth score). The major variable of interest is race which has four categories (African, Coloured, Asian and White).

Stata is used to find the estimated coefficients of the independent variables using maximum likelihood estimation methods. The significance of the independent variable is tested by using the p-value of its coefficient. A p-value less than the level of significance signifies that the coefficient (and hence the variable) is significant in the model and vice versa. The Wald test is also used to see whether the addition of a variable in the model makes the model better or not. The tests are performed at the five per cent significance level unless otherwise stated.

4.3 Findings on whether a woman has ever given birth

To test the effects of race on whether a woman has ever given birth or not, several models are built and the one that best explains whether a woman has ever given birth or not is chosen. Dummy variables for all categorical variables that had more than two categories were generated so that they carried the values 1 for those who had that attribute and 0 for those who did not have the attribute.

The first step was to fit a simple regression model with one explanatory variable. Since race is the major variable of interest, the first model has race as the explanatory variable and is maintained in the model even if it is not significant. More variables are then included, one by one, until all the considered variables have been tested. The Wald test is also used to test whether the included variable is significant or not.

In assessing the effect of an independent variable on whether a woman has ever given birth, one faces the challenge that as age increases, the population becomes increasingly select and that the socio-economic variable does not reflect the status of the woman at the time of birth. For example, a 45 year old woman who gave birth at the age of 18 is evaluated on her characteristics now. This is not reasonable as her characteristics 27 years ago will not be reflected now.

To avert this selection problem, a binary variable is generated so that at age 20 we have the number of women who have ever given birth and the number of those who have not. We do the same at age 25. The variables are generated by calculating a woman's age at the first birth then create a dummy so that the number 1 implies that the woman has given birth at or before a given age x (in this case age 20 and age 25) and 0 if she is yet to give birth by this age. We also include women who have never given birth by coding their age at first birth as 99 and exclude those who are yet to attain age x and have never given birth.

Table 4.1 gives the distribution of women aged 20-24 and 25-29 who have had their first birth by age 20 and 25 respectively. About 46 per cent of women aged 20-24

had their first birth by age 20 while about 77 per cent of women aged 25-29 had their first birth by the age of 25. Since the samples have become smaller, we have few women with no education. We reconstruct the education variable to be included in the logistic regression models such that we collapse the "no education" category and the "primary school education" category become one.

Table 4.1: Distribution of women 20-24 and 25-29 giving birth by age 20 and age 25

	Age at first	No		Yes		Total	
Age	Birth	Number	Per cent	Number	Per cent	Number	Per cent
20-24	20	665	53.63	575	46.37	1,240	100
25-29	25	208	23.14	691	76.86	899	100

We apply logistic regression to data on women aged 20-24, testing the effect of race on whether a woman has given birth by age 20 after controlling for the effect of other variables. We also apply logistic regression to data on women aged 25-29, testing the effect of race on whether a woman has given birth by the age of 25. One applies the models to these ages because most women will have their first births in these age groups and as such the selection effect and the current status problem will be minimised. We begin by applying a model with age and race as the explanatory variables and then fit another model which includes explanatory variables in the first model and other social variables. Economic variables are added to the variables in the second model to fit a third model.

Odds ratios together with their p-values are presented in all the models including a number of observations in a model and p-value for model F-Statistic. It would have been helpful to present R^2 or pseudo R^2 for the model to see how much the model explains variability on whether a woman has ever given birth or not. However, since we are using survey data, the assumptions for calculating R^2 or pseudo R^2 are not met as observations are not independently and identically distributed, and we therefore do not present R^2 or pseudo R^2 for the model. Instead, p-values for the model F-statistic are presented, which tests the null hypothesis that the slope parameters are jointly equal to zero.

Table 4.2 presents results for the logistic regression showing the effect of independent variables on whether a woman has ever given birth by age 20 for women aged 20-24. We expect that change in status of the mother between the time of birth and the time of interview might not have changed significantly for all women when one considers variables like education and poverty status. We also consider poverty in the logistic regression of the first birth by age 20 and age 25 because the chances are very

low that someone who was not poor (or was poor) at time *x* will be classified as poor (or not poor) at time *x+n* given *n* is small enough and other factors like (winning a lottery, fire, robbery etc.) are held constant. Assuming for example that the largest value n can take is 5, chances are that if a woman was classified as poor at the beginning of the period and has been classified as rich at the end of the period she was already in the transition from being poor to being rich at the beginning of the time interval. The decision to have or not to have a child in the ensuing period will therefore take into account the economic situation she is facing ahead of her rather than the situation she has is leaving. Therefore, if the survey date comes at the end or during the transitional period, the information on the children she has given birth to during this period will reflect the situation she is facing at the end of the transition.

Table 4.2: Logistic regression results, given birth by age 20 (all women 20-24)

	Model 1		Model 2			Model 3		
	Odds Ratio	P>t	Odds Ratio	P>t		Odds Ratio	P>t	
Age	4.8420	0.4640	3.1336	0.6030		3.0913	0.5990	
Age2	0.9660	0.4780	0.9746	0.6040		0.9747	0.5970	
Race								
African (Ref)								
Coloured	1.0463	0.8570	1.0965	0.6840		1.3992	0.1310	
Indian	0.9431	0.9490	0.8222	0.8630		1.2932	0.7790	
White	0.5027	0.3590	0.5859	0.3990		1.3420	0.6240	
Education								
Higher (Ref)								
Primary and no education			3.9371	0.0020	***	2.0703	0.1190	
Secondary			2.5303	0.0030	***	1.8844	0.0410	**
Area of residence								
Rural (ref)								
Urban			0.6545	0.0200	**	0.8321	0.3500	
Marital Status								
Married (Ref)								
Living with partner			0.5357	0.1950		0.5838	0.2530	
Formerly Married			0.0404	0.0280	**	0.0552	0.0350	**
Never Married			0.3734	0.0230	**	0.3456	0.0090	***
Employment Status								
Not Economically active (Ref)								
Unemployed			1.8694	0.0030	***	1.8546	0.0040	***
Employed			1.4866	0.0730	*	1.8374	0.0090	***
Log income						0.8608	0.1340	
Log Expenditure						0.6646	0.0000	****
Model number of obs.	1238		1224			1222		
Model Prob > F	0.8599		0.0016			0.0000		

NOTE: *p≤0.1 **p≤0.05 ***p≤0.0.01 ****p≤0.001

The table shows that race is not significant in determining whether a woman has ever given birth by age 20 for all women aged 20-24. In all the models, the table shows that the odds of giving birth by age 20 are not statistically different between Coloured women and African women, between Asian women and African women and between White women and African women. We, however, notice that the addition of other social variables does not affect the effect of race much but that the addition of economic variables does. The odds ratios between African women and women of each of the other population groups have significantly risen. When one controls for other social and economic variables, Coloured women appear to be more likely than African women to have given birth by age 20. This applies to the comparison of the odds between African and Indian and African and White women. Thus the results show that race is not a determinant of the probability of giving birth and that other variables account for the differentials in fertility for women aged 20-24. They also show that most of the differentials in race data are explained by economic factors. They show that the effect of the other social factors on the effect of race is small. They also show that using race as a proxy for economic factors might produce insignificant results while economic factors do affect significantly the probability of giving birth by age 20. These results need to be treated with circumspection as they might be heavily affected by the small sample size of Indian and White women.

The results also show that the effect of education on whether a woman gives birth by the age of 20 is greatly affected by whether one controls for economic variables or not. There is no significant difference in the odds of giving birth by age 20 for women with higher education and those with primary and no education when economic variables (household income and per capita expenditure) are controlled for. However, there is a significant difference in the odds of giving birth between women with primary or no education and those with higher education when one does not control for income and expenditure. The odds are about 4 times that a woman with primary school or no education will have given birth by age 20 when compared to a woman with higher education ($p<0.01$).

When one does not control for income and expenditure, women with secondary education are about 2.5 times more likely to give birth by age 20 compared to their counterparts with higher education ($p<0.01$). On the other hand, when one controls for the economic variables, women with secondary education are 1.9 times more likely to have given birth by age 20 compared to those with higher education ($p<0.05$).

It is interesting to note that when we control for income and expenditure, there is no significant difference in the odds of giving birth by age 20 for women with higher education and those with primary school or no education while the difference is still significant between women with higher education and secondary education. This might be due to the income and expenditure data not capturing all the heterogeneity amongst women with primary school or no education while the heterogeneity is properly captured amongst women with secondary education.

The effect of urban rural residence on whether a woman gives birth is also altered by the inclusion or exclusion of income and expenditure. When one does not control for income and expenditure, women in an urban area are about 34 per cent less likely to have given birth by age of 20 when compared to their rural counterparts ($p<0.05$). However, when one controls for income and expenditure, the odds of giving birth by age 20 are not statistically different for women in urban and rural areas.

The effect of marriage on whether a woman has given birth by age 20 is less affected by the inclusion of income and expenditure in the model. The probability of giving birth by age 20 is not significantly different between married women and those living with their partner regardless whether we control for income and expenditure. On the other hand, irrespective of whether we control for income and expenditure, formerly married women are about 95 per cent less likely to have given birth by age 20 compared to their married counterparts ($p<0.05$). If we do not control for income and expenditure, women who have never been married are 62 per cent less likely to have given birth by 20 when compared to their counterparts who are currently married, while if we control for the same, never married women are 65 per cent less likely to have given birth by age 20 compared to their married counterparts. This shows that the effect of marriage on the probability of giving birth by age 20 for women aged 20-24 is strong.

The effect of employment is also less affected by the inclusion of income and expenditure in the model. If we do not control for income and expenditure, unemployed women have the odds of 1.87 ($p<0.01$) to have given birth than their counterparts who are not economically active while when we control for income and expenditure, the odds are almost the same. When we do not control for income and expenditure, employed women have the odds of 1.49 ($p<0.1$) to have given birth compared to their counterparts who are not economically active while when we control for income and expenditure, employed women have the odds of 1.84 ($p<0.01$) to have given birth than their counterparts who are not economically active.

For the economic variables added in the final model, income does not have a significant effect on the probability of giving birth by age 20 while expenditure does. A ten per cent increase in expenditure will reduce the probability of giving birth by about 33 per cent ($p<0.001$). Considering that expenditure is more dependent on income, the insignificance of income might imply that the income data is not capturing all forms of income. The other economic variables (poverty indicator, consumer durable score, consumer and housing durable score and DHS-style wealth score) did not improve the final model and were therefore excluded.

Table 4.3 presents results for the effects of the explanatory variables on whether a woman has given birth by the age of 25 when applied to women aged 25-29. The results do not deviate much from those presented on the probability of giving birth by age 20 for women aged 20-24. Just as with the results on the probability of giving birth by age 20, the results show that race does not have significant effects on the probability of giving birth by age 25. However, they also show that the effect of race is altered differently when compared with how it is altered when applied to women aged 20-24. When one adds social variables alone to the model (model 2), the effect of race improves from the model that included race and age only. However, the inclusion of economic variables lessens the effect of race (model 3). When one does not include other factors in the model, White women are 61 per cent less likely to have given birth by age 25 compared to their African counterparts ($p<0.1$). However, when one considers social factors, White women are 72 per cent less likely to have given birth by age 25 compared to their African counterparts ($p<0.05$) while when one controls for both social and economic factors, the probability of giving birth between women of the two population groups is not statistically different.

While the effect of education on the probability of giving birth by age 20 is significant (Table 4.2), it appears to be less significant when we look at the probability of giving birth by age 25 (Table 4.3). The results indicate that when one does not control for income and expenditure, the effect of education on the probability of giving birth by age 25 is small when compared to the effect of education on the probability of giving birth by age 20. This implies that unlike younger women, the probability of having a first birth for older women is not greatly affected by the level of education attained.

Table 4.3: Logistic regression results, given birth by age 25 (All women 25-29)

	Model 1			Model 2			Model 3		
	Odds Ratio	P>t		Odds Ratio	P>t		Odds Ratio	P>t	
Age	0.0014	0.1020		0.0012	0.0840	*	0.0004	0.0560	*
Age2	1.1280	0.1040		1.1317	0.0870	*	1.1527	0.0590	*
Race									
African (Ref)									
Coloured	0.7841	0.5230		0.7434	0.4150		0.8929	0.7370	
Indian	0.4137	0.3770		0.2138	0.2420		0.5939	0.7090	
White	0.3882	0.0920	*	0.2821	0.0340	**	0.5553	0.3330	
Education									
Higher (Ref)									
Primary and no education				2.0144	0.1070		1.0045	0.9930	
Secondary				2.6127	0.0030	***	1.7149	0.1610	
Area of residence									
Rural (ref)									
Urban				0.5743	0.0240	**	0.8603	0.5660	
Marital Status									
Married (Ref)									
Living with partner				0.5884	0.2850		0.4135	0.1060	
Never Married				0.3554	0.0110	**	0.2340	0.0010	****
Log income							0.7533	0.1040	
Log Expenditure							0.6423	0.0020	***
Model number of obs.	899			889			888		
Model Prob > F	0.3275			0.0006			0.0000		

NOTE: *p≤0.1 **p≤0.05 ***p≤0.0.01 ****p≤0.001
Formerly married predicts success perfectly with 7 observations dropped

The other difference between the results in Table 4.3 and those in Table 4.2 is that employment status is does not improve have a significant effect on the probability of giving birth by age 25 and that its inclusion in the model does not make the model better.

4.4 Findings on children ever born

As discussed in section 4.2, measurement of the effect of social and economic variables on children ever born is relatively well handled by Poisson regression, since it is a count. However, while parity increases with age, the variance does too, and there is a risk that as a result the variance might be over dispersed. As a result of this, using a negative binomial might be preferable. An alternative however might be to standardise the response variable, children ever born by each single year of age *x* so that we should take out the effect of age. For each single year of age *x*, we calculate a weighted mean of children ever born. We then divide the observed children ever born for each woman by the calculated weighted mean children ever born at that given age.

This standardised children ever born has a mean of 1. It is no longer a count variable but is still non-negative. Applying a Poisson regression or a negative binomial approach will be inappropriate. We therefore use a linear regression to model the standardised children ever born. Thus the assumptions necessary for the application of linear regression, as stated in section 4.1, will be adopted in assessing the relationship between children ever born and the independent variables.

The linear regression is applied to data on all women to see the effects of the explanatory variables on the standardised measure of lifetime fertility. We apply first to a model with race alone, then to another one which includes social factors, and then another one with both social and economic factors. For categorical explanatory variables that have more than two categories, the same procedure of creating dummy variables is followed, as in section 4.3. We present results for the model coefficients and their p-values, including the number of observations in each model and the R-squared for each model. We also present results for education with four categories as there are enough women in each of the four education categories for us to proceed with the regression models.

Table 4.4 shows the results for linear regression to test the effect of the explanatory variables on the number of children a woman has ever given birth to. It can be observed that the values of model R-squared for all the three models are very small. This implies that there is a lot of variance in lifetime fertility that is not explained by the covariates included in the models.

The results show that the effect of race on lifetime fertility diminishes as we add more variables thereby showing that the effect of race on lifetime fertility is attenuated by the inclusion of other socio-economic variables. When we do not control for any other factors, Coloured women have 0.11 children less than African women even though the difference is not statistically significant. Indian women have 0.39 children less than African women ($p<0.001$) while White women have 0.38 children less than their African counterparts ($p<0.001$). Race continues to be significant when we control for other social factors without controlling for economic factors (household income, per capita expenditure, consumer durable score and DHS-style wealth score). The inclusion of these socio-economic factors has not greatly affected the coefficients of lifetime fertility between African women and Coloured women and between Asian women and African women. However, the coefficients of lifetime fertility between African women and White women have changed a lot. This is evidence that inclusion of more variables

modifies the effect of race on fertility. The difference in the number of children born to Coloured and African women is still not significant but the difference has decreased in absolute terms. On the other hand, Indian women have 0.34 children less when compared to their African counterparts ($p<0.001$) while White women have 0.24 children less than their African counterparts. When one controls for economic variables and other social variables, race does not have an effect on the number of children ever born to a woman. This is different from the results in model 1 and model 2. This implies that much of the difference in lifetime fertility between African women and Indian women and between African women and White women as presented in models 1 and 2 is due to other factors and not race itself.

Table 4.4: Regression results, children ever born (All women 15-49)

	Model 1			Model 2			Model 3		
ceb2	Coeff.	P>t		Coeff.	P>t		Coeff.	P>t	
Race									
African (Ref)									
Coloured	-0.1061	0.1210		-0.0912	0.1330		-0.0457	0.4640	
Indian	-0.3931	0.0000	****	-0.3421	0.0000	****	-0.1365	0.1420	
White	-0.3805	0.0000	****	-0.2386	0.0010	***	-0.0209	0.8060	
Marital Status									
Married (Ref)									
Living with partner				-0.1107	0.0730	*	-0.1117	0.0440	**
Formerly Married				-0.1596	0.0000	****	-0.1627	0.0000	****
Never Married				-0.2866	0.0000	****	-0.3504	0.0000	****
Education									
Higher (Ref)									
No-Education				0.4635	0.0000	****	0.2142	0.0330	**
Primary				0.6605	0.0000	****	0.4209	0.0190	**
Secondary				0.2144	0.0000	****	0.0720	0.1000	*
Area of residence									
Rural (ref)									
Urban				-0.2186	0.0000	****			
Employment Status									
Not Economically active (Ref)									
Unemployed				0.2684	0.0050	***	0.2477	0.0150	**
Employed				0.0773	0.2190		0.1247	0.0830	*
Log income							0.0814	0.0460	**
Log expenditure							-0.2127	0.0000	****
Consumer durable score							0.1320	0.0000	****
DHS-style wealth score							-0.1564	0.0000	****
Constant	1.0470	0.0000					1.6252	0.0000	****
Model number of obs.	6653			6573			6547		
Model R-squared	0.0043			0.0304			0.0434		

NOTE: *p≤0.1 **p≤0.05 ***p≤0.0.01 ****p≤0.001

The results show that the there is a not much difference in terms of the effect of marital status on children ever born when one controls for other social factors alone and when one controls for social factors and economic factors. There is no significant difference in the two models in the number of children born to women living with their partner and those who are married even though the former appear to have lesser children. There is a significant difference between the number of children ever born to a woman who is currently married compared to the number of children ever born to a woman who was formerly married ($p<0.001$) and also for the number of children born to a woman who has never been married compared to a woman who is currently married ($p<0.001$). A woman who was formerly married has about 0.16 children less than a married woman regardless of whether you control for other social factors alone or you control for other social factors and economic factors. A woman who has never been married has 0.29 children less than her married counterpart when we control for other social factors alone and she has 0.35 children less than a married woman when we control for other social factors and economic factors. These results imply that marriage has a strong effect on life time fertility.

The p-values for education categories show that the effect of education on life time fertility is also affected by economic factors. When we do not control for economic factors, women with no education have 0.46 children more than their counterparts with higher education ($p<0.001$), women with primary education have 0.66 children more than their counterparts with higher education ($p<0.001$) while those with secondary education have 0.21 children more than their counterparts with higher education ($p<0.001$). When we control for economic factors, women with no education have 0.21 children more than their counterparts with higher education ($p<0.05$), women with primary education have 0.42 children more than their counterparts with higher education ($p<0.05$) while those with secondary education have 0.07 children more than their counterparts with higher education ($p=0.1$).

When we do not control for economic factors, women living in urban areas have 0.22 children, less than their counterparts in rural areas ($p<0.001$) while when we control for economic factors the effect of place of residence is not significant and does not add anything to the power of the model. It is therefore omitted in the final model.

The results also show that the effect of employment on life time fertility is also significant and is greatly affected by the inclusion of income, expenditure and the score variables in the model. When we do not control for income, expenditure, consumer

durable score and DHS-style wealth score, the difference in life time fertility of employed and not economically active women is not significant while unemployed women have 0.27 children more than their counterparts who are not economically active ($p<0.01$). On the other hand, controlling for income, expenditure, consumer durable score and DHS-style wealth score, unemployed women have 0.25 children more than their counterparts who are not economically active ($p<0.05$) while employed women have 0.12 children more than not economically active women ($p<0.1$).

The results also show that there is a significant effect of household income ($p<0.05$), per capita expenditure ($p<0.001$), consumer durable score ($p<0.001$) and DHS-style wealth score on life time fertility. A ten per cent increase in household income is likely to result in a 0.08 increase in the number of children ever born while a ten per cent increase in per capita expenditure is likely to result in a 0.21 decrease in the number of children ever born. A unit increase in consumer durable score is likely to result into a 0.13 increase in the number of children ever born while a unit increase in DHS-style wealth score will result into a 0.16 decrease in the number of children ever born.

In general, the results on lifetime fertility show that the effects of race are greatly reduced by other factors. They show that most of the differentials in lifetime fertility are largely due to marriage and economic factors with the later having a greater impact.

4.5 Effects of socio-economic factors on fertility of African women

As shown in chapter 3, data for Coloured, Asian and White women are sparse and insufficient. The small sample size poses a challenge in statistical analysis as predictive power of a model is decreased. Due to the small sample size, confidence intervals are increased and significant results might not be identified as such.

Due to the problems highlighted above, this section seeks to establish whether socio-economic factors have an effect on fertility by looking at data for African women only. We apply logistic regression models and linear regression models as in section 4.3 and section 4.4 to data for African women.

4.5.1 Results: The probability of giving birth by age 20 and age 25 (African women)

Logistic regression models are used to assess whether socio-economic factors matter in determining whether an African woman has given birth by the age of 20 and by the age of 25. We follow a similar procedure of model building as in section 4.3 but we do produce two models for each response variable. The first model does not include economic variables (household income and per capita expenditure) while the second

does. We present results for all African women aged 20-24 giving birth by age 20 first and then results for all African women aged 25-29 giving birth by age 25. Table 4.5 shows the logistic regression results for testing the effects of the explanatory variables on whether an African woman aged 20-24 has ever given birth by the age of 20. It also presents the number of observations in the model and the p-value for the model F-statistic.

Table 4.5: Regression results: Given birth by age 20 (African women 20-24)

	Model 1			Model 2		
	Odds Ratio	P>t		Odds Ratio	P>t	
Age	24.1954	0.1600		26.0306	0.1490	
Age2	0.9312	0.1660		0.9297	0.1540	
Education						
Higher (Ref)						
Primary and no education	3.1902	0.0110	**	1.9432	0.1530	
Secondary	2.1240	0.0260	**	1.7065	0.1180	
Area of residence						
Rural (ref)						
Urban	0.6203	0.0120	**	0.7605	0.1790	
Marital Status						
Married (Ref)						
Living with partner	0.7362	0.5190		0.8043	0.6410	
Never Married	0.5182	0.0900	*	0.5076	0.0700	*
Employment Status						
Not Economically active (Ref)						
Unemployed	1.8001	0.0080	***	1.7537	0.0110	**
Employed	1.4703	0.1330		1.7012	0.0480	**
Log income				0.9133	0.3530	
Log Expenditure				0.7095	0.0020	***
Model number of obs.	1025			1023		
Model Prob > F	0.0029			0.0000		

NOTE: *p≤0.1 **p≤0.05 ***p≤0.0.01 ****p≤0.001
Formerly Married omitted (3 observations). Predicts failure perfectly

The results show that for African women aged 20-24, the probability that an African woman gives birth by age 20 greatly relies on per capita expenditure, employment status and marital status. If we control for income and expenditure, the effect of education, place of residence, and income on whether an African woman gives birth by age 20 is not significant. If we do not control for income and expenditure, an African woman with primary or no education is 3 times more likely to have given birth by the age of 20 than an African woman with higher education ($p<0.05$). On the other hand, the odds of giving birth by age 20 are twice as much for an African woman with secondary education as those of an African woman with higher education ($p<0.05$) if we

do not control for household income and per capita expenditure. The results also show that if we do not control for income and expenditure, the odds of giving birth for urban women is 38 per cent less than those for rural women.

The results also show that for African women aged 20-24, marriage does not greatly affect the probability of giving birth by age 20. An African woman aged 20-24 who has never been married is 48 per cent less likely to have given birth compared to a woman who is currently married ($p<0.1$) when we do not control for income and expenditure and 49 per cent less likely to have given birth compared to a woman who is currently married ($p<0.1$) when income and expenditure are controlled for. There is no difference in the probability of giving birth by age 20 for women who are living with their partner and women who are married irrespective of whether we control for income and expenditure. On the other hand, the results for women who were formerly married predicted failure perfectly in both models. This is mainly due to the inadequacy of the data to perform the test on these women.

The effects of income on the probability of giving birth by age 20 are not significant while the effects of expenditure are. A ten per cent increase in expenditure is likely to reduce the odds of giving birth by 29 per cent.

The effects of poverty status, employment, consumer durable score and DHS-style wealth score are not significant and do not help improve the model. They have therefore been dropped out of the model.

Table 4.6 shows results of the logistic regression on whether an African woman has ever given birth by the age of 25 or not for all African women aged 25-29. The results show that for women aged 25-29, expenditure and marriage explains most of the variations in the probability of an African woman giving birth by age 25. There is no significant difference in the probability of giving birth by age 25 between women with primary or no education and women with higher education. On the other hand the probabilities of giving birth between women with secondary education and those with higher education are significantly different only when we do not control for income and expenditure. A woman with secondary education is twice more likely to have given birth by age 25 compared to her counterpart with higher education ($p<0.05$).

Table 4.6: Logistic regression results: Given birth by age 25 (African women 25-29)

	Model 1			Model 2		
	Odds Ratio	P>t		Odds Ratio	P>t	
Age	0.0007	0.0690	*	0.0004	0.0560	*
Age2	1.1440	0.0700	*	1.1576	0.0590	*
Education						
Higher (Ref)						
Primary and no education	1.7747	0.2130		0.9379	0.9110	
Secondary	2.2596	0.0200	**	1.5811	0.2800	
Area of residence						
Rural (ref)						
Urban	0.5809	0.0310	**	0.8329	0.4930	
Marital Status						
Married (Ref)						
Living with partner	0.6194	0.3900		0.5177	0.2590	
Never Married	0.3788	0.0330	**	0.2872	0.0080	***
Log income				0.7988	0.2320	
Log Expenditure				0.6558	0.0070	***
Model number of obs.	739			739		
Model Prob > F	0.0016			0.0002		

NOTE: *p≤0.1 **p≤0.05 ***p≤0.0.01 ****p≤0.001
Formerly married omitted, 3 observations predicts success perfectly.

The results also show that marriage has a significant effect on whether a woman gives birth by age 20. An African woman who has never been married is about 63 per cent less likely to have given birth by the age of 25 relative to an African woman who is married ($p<0.05$) if we do not control for income and expenditure. On the other hand, the same woman is about 72 per cent less likely to have given birth if we do control for income and expenditure ($p<0.01$). However, there is no significant difference between an African woman who is living with her partner and the one who is married regardless of whether we control for income and expenditure. The test for women who were formerly married predicted success perfectly and hence removed from the model.

The effect of household income on whether a woman gives birth by age 25 for African women aged 25-29 is not significant. However, the effects of per capita expenditure on whether an African woman aged 25-29 has given birth by age 25 are significant. For all African women aged 25-29, a ten per cent increase in per capita expenditure reduces the odds of giving birth by about 34 per cent ($p<0.01$).

There are no significant effects of poverty, employment, consumer durable score and DHS-style wealth score and these do not improve the model.

4.5.2 Children ever born to African women

In assessing whether socio-economic factors do have an effect on the number of children ever born to an African woman, we fit a linear regression model as in section 4.4, applying them to data for African women only. We again use the standardised number of children ever born as the response variable in the model.

Table 4.7 shows regression results for the effects of the explanatory variables on children ever born to an African woman. We present results for two models. One model has social covariates while the other has both social and economic covariates. It can be observed from the table that the amount of variance in the dependent variable that can be explained by the two models is very small (R-squared = 0.03 for model 1 and 0.04 for model 2). This implies that the models do not capture all the heterogeneity in the data.

Table 4.7: Linear regression results: children ever born (African women 15-49)

	Model 1			Model 2		
ceb2	Coefficient	P>t		Coefficient	P>t	
Marital Status						
Married (Ref)						
Living with partner	-0.0669	0.3020		-0.0643	0.3040	
Formerly Married	-0.1637	0.0020	***	-0.1452	0.0100	***
Never Married	-0.2524	0.0000	****	-0.3094	0.0000	****
Education						
Higher (Ref)						
No-Education	0.5303	0.0000	****	0.2939	0.0100	***
Primary	0.7111	0.0000	****	0.4925	0.0180	**
Secondary	0.2359	0.0000	****	0.1038	0.0750	*
Area of residence						
Rural (ref)						
Urban	-0.2284	0.0000	****	-0.0780	0.4250	
Employment Status						
Not Economically active (Ref)						
Unemployed	0.2813	0.0110	**	0.2697	0.0140	**
Employed	0.1011	0.1770		0.1404	0.0960	*
Log income				0.0987	0.0360	**
Log expenditure				-0.1929	0.0000	****
Consumer durable score				0.1096	0.0640	*
DHS-style wealth score				-0.1362	0.0290	**
Constant	0.9257	0.0000		1.3397	0.0000	
Model number of obs.	5275			5290		
Model R-squared	0.0251			0.0355		

NOTE: *p≤0.1 **p≤0.05 ***p≤0.0.01 ****p≤0.001

The results show that when other factors are held constant, marriage has a significant effect on the number of children ever born to a woman regardless of whether we control for economic variables or not. It can be seen that when economic factors are not controlled for, there is a significant difference in the number of children born to a married woman compared to those born to a woman who was formerly married ($p<0.01$). A woman who was formerly married has 0.16 children less when compared to a married woman. On the other hand, when we control for economic factors, a woman

who was formerly married has 0.15 children less than a woman who is currently married ($p<0.01$). The results also show that a woman who has never been married is likely to have about 0.25 lesser children than her married counterpart ($p<0.001$) if we do not control for economic factors and 0.31 children lesser if we do. They also show that there is no significant difference in the number of children ever born to a married woman compared to a woman living with her partner regardless of whether we control for economic factors or not.

The results further show that the effects of education on the number of children ever born to a woman are significant. A woman with no education is likely to have 0.53 more children than a woman with higher education ($p<0.001$) if we do not control for economic variables and 0.29 children more when economic variables are controlled for. A woman with primary education has 0.71 ($p<0.001$) more children than her counterpart with higher education if we do not control for economic variables and 0.49 more children than her counterpart with higher education if we control for economic variables ($p<0.05$). If we do not control for economic variables, the number of children ever born to a woman with secondary education is 0.24 more than that born to women with higher education ($p<0.001$) while the same woman has 0.10 more children when economic variables are controlled for ($p<0.1$).

There are no significant differences in the number of children ever born to urban and rural women if we control for economic factors while the difference is significant when we do not control for economic factors. If we do not control for economic factors, an urban woman has 0.23 less children when compared to a rural woman ($p<0.001$).

The effect of employment on number of children ever born to an African woman is also significant and the inclusion of the other economic variables in the model greatly affects it. When we do not control for income, expenditure, consumer durable score and DHS-style wealth score, the difference of the number of children ever born to employed and not economically active women is not significant while unemployed women have 0.28 children more than their counterparts who are not economically active ($p<0.05$). On the other hand, when we control for the other economic variables, unemployed women have 0.27 children more than their counterparts who are not economically active ($p<0.05$) while employed women have 0.14 children more than not economically active women ($p<0.1$).

The results also show that household income ($p<0.05$) and per capita expenditure ($p<0.001$) have significant effects on the number of children ever born to an African woman. While the effects of household income on the number of children a woman has ever given birth to are positive, the effects of expenditure are negative. A ten per cent increase in household income is likely to result in an approximately 0.10 increase in the number of children ever born while a ten per cent increase in expenditure will lead to an average decline of 0.19 children.

The effects of consumer durable score on the number of children ever born are also significant ($p<0.1$). An increase in the score for an African woman will result in a 0.11 increase in the number of children ever born. On the other hand, a unit increase in DHS-style wealth score will result in a decline of 0.14 children ever borne to an African woman ($p<0.05$).

The effect of poverty indicator was not statistically significant and did not improve the model and hence it has been dropped.

4.6 Discussion

This section gives a summary of what the results in section 4.3, section 4.4 and section 4.5 imply and attempts to look at how much they meet the objectives of this chapter and assess whether they are consistent with what has been presented before by other researchers. In general, the results show that race does not have a significant effect on fertility and that if one adequately controls for other socio-economic factors the effect of race is minimised further.

4.6.1 Probability of having given birth by age 20 and by age 25

The results show that the effect of race on the probability of giving birth by age 20 and age 25 is not significant. They show that there is no difference in the odds of giving birth by age 20 for African women aged 20-24 and women of any of the other three population groups (Coloured, Asian and White) in the same age bracket. This holds even when we control for education, area of residence, marital status, income and expenditure. Similar results were observed when we considered the odds of giving birth by the age of 25 for all women aged 25-29. This is different to what Sibanda and Zuberi (2005) found when they analysed data from the 1996 South African Population Census. They found that race had a significant effect on fertility and that the odds of having a first birth by age 19-20 and the odds of having a first birth by age 25-26 were statistically different between White women and women of any of the other three population

groups. However, their study did not control for income and expenditure but controlled for other factors such as province of residence and religion.

Much as data for Coloured, Asian and White women are inadequate in the NIDS study (as shown in section 3.2.1 and section 3.2.2), the lack of consistency between the two studies might also be attributed to other variables controlled for in the two studies. However, even when we do not control for income and expenditure, our results are different from those of Sibanda and Zuberi. One other reason could be that the difference in time period for collection of data in the two studies is large and that their sample population is larger than the one we use in the NIDS.

Another major finding in this study with regards to race is that the inclusion of measures of wealth (income and expenditure) alters the effect of race significantly. It can be observed from Table 4.2 and Table 4.3 that odds ratios for women of the other three population groups in relation to African women have significantly changed with the inclusion of income and expenditure in the model. There is a significant change in the power of the test for the odds ratios for race. The inclusion of other socio-economic variables without the inclusion of income and expenditure does not change the effect of race on the probability of giving birth significantly. This shows that when one controls for other variables the effect of race is very small and is much smaller when measures of wealth are controlled for.

The results on the probability that an African woman aged 20-24 and the one aged 25-29 has given birth by age 20 and 25 respectively show that there is heterogeneity in these groups of women. The results show that there are other factors affecting fertility of these women and that the effect of income and expenditure on the probability of giving birth by the age of 20 and by the age of 25 is more profound. The inclusion of income and expenditure makes other variables less significant. The effects of education and place of residence are not significant when we add in income and expenditure to the model for African women aged 20-24 and African women aged 25-29. On the other hand, the effects of marriage are also reduced when income and expenditure are incorporated. Since data for African women show that there are other factors which affect the probability of giving birth by the age of 20 and by the age of 25, it is proper to conclude that race might not be a better proxy for measuring the effect of social status on fertility of these women.

4.6.2 Factors affecting lifetime fertility

Like the probabilities of giving birth by age 20 and by age 25, the effect of race on the number of children a woman has ever borne is greatly affected by the variables included in the model. When we do not include measures of wealth (household income, per capita expenditure, consumer durable score and DHS-style wealth score), there are significant differences in the numbers of children ever born to women of different races. However, when we include measures of wealth, the effects of race are significantly affected.

This implies that in principle, race does not matter in determining the number of children that a woman is going to have. However, with lack of data on other factors, one could easily conclude that race determines the number of children a woman is likely to have borne. This is however, erroneous as the differences in the number of children ever born to a woman are largely due to other factors than race. In this study, we find that the effects of marriage and wealth on fertility are more significant than the effects of education, place of residence and race and thus the differences in the number of children ever born are primarily due to these factors.

Another observation made in results for both the logistic regression and the linear regression is that marriage and expenditure are important in explaining fertility differentials. In terms of marriage, the results confirm what we have already known on how marriage affects fertility that single women are less likely to have more children than a women who is currently married and that who has been married before. The results on income and expenditure are fairly consistent with the observation by Thomas (1999) that income has a depressing effect on fertility.

In this chapter we examined the effects of race on fertility. We conclude that the effect of race is minimal when we control for income and expenditure. In general, if we do not control for income and expenditure the effect of race on the number of children is significant but not significant on the probability of motherhood by age 20 and by age 25. We have also seen that in the absence of data on economic factors, using race as a proxy to determine the effects of income and expenditure on fertility could produce unrealistic results. We also conclude that the effect of marital status on fertility is very significant just like the effect of expenditure. If we do not control for income and expenditure, education and place of residence are also significant on both the probability of giving birth by age 20 and 25 and on the number of children ever born. However, the effects of these factors do not greatly affect the effects of race on fertility. We also

conclude that African women are not a homogenous group and hence their status of being African cannot be used as a determinant of their childbearing choices as this is affected by other factors.

5 CONCLUSION

The purpose of this study was to assess the effect that race has on fertility if one adequately controls for socio-economic factors. The methods of assessment were regression models which were operationalised by looking at fertility in terms of whether a woman has ever given birth by age 20 and age 25 and in terms of the number of children ever born to a woman. The findings show that there are no significant differences in the probability of giving a first birth by age 20 and age 25 for women of different population groups. On the other hand, there are significant differences in lifetime fertility of women of different population groups when we do not control for economic factors while the differences are not significant when economic factors are controlled for. In all regression models, the effects of race are attenuated by the addition of economic factors. In this chapter, we present the limitations of the study before we conclude.

5.1 Limitations

Inadequate data for some population groups makes it difficult to assess how much race affects fertility. As observed in chapter 3, data for Coloured, Asian and White women are too few to produce reliable estimates. With more data being lost, the statistical power of the tests conducted has been lost. This implies that in some cases it is possible that for the regression models especially where we looked at the probability of giving birth by age 20 and by age 25 to a small sample of women, the results might have been insignificant while on the ground they are significant. It would have helped if NIDS collected data from more Coloured, Asian and White women.

The lack of data on the proximate determinants in the NIDS study makes it difficult to conclude how much of the other socioeconomic variables affect fertility. For purposes of comparability with other surveys such as DHS data and for purposes of studying the effects of the proximate determinants of fertility, it would have helped if NIDS had collected data on the proximate determinants. With the availability of rich socioeconomic data in the NIDS, the inclusion of proximate determinants data would provide a better understanding of the effects of socioeconomic variables on fertility.

The analysis on whether a woman has given birth or not has focused on women aged 20-24 and women aged 25-29 so as to avert the effect of current status problems. However, if we had longitudinal data, we would have looked at whether a woman has

given birth by a given age for all women of childbearing age. This would have helped us know how much over time the effects of race on whether a woman has given birth has changed and if the effects of the other socio-economic variables have changed or stabilised in affecting the effects of race. Longitudinal data would also help us do a comprehensive study on how income distribution has changed by population group and see how fertility has changed as well.

It has been seen in chapter 4 that not all heterogeneity is captured in lifetime fertility models and that the income data might not be capturing all forms of income. It would have helped if these were further investigated. However, time constraints have not allowed us to investigate this. Future research might therefore investigate these two issues.

5.2 Conclusion

The results presented confirm our hypothesis that when one adequately controls for other background factors, race is not significant in determining fertility. They show that unless one adequately controls for other socio-economic factors, the effect of race on fertility is exaggerated. With a South African political background that has exacerbated inequality among the racial groups, it is erroneous to consider the effects of race on fertility without adequately controlling for other background factors.

The results on the probability of giving birth by age 20 and age 25 and on lifetime fertility for African women show that there is heterogeneity in fertility for African women. Since apartheid policies on separate development impacted negatively on Africans in terms of access to resources, the overall impact of racial stratification on African women's fertility has not been significant. The heterogeneity in fertility for African women implies that fertility outcomes have been influenced by individual characteristics and choices other than group characteristics.

The results also point out the importance that household income and per capita expenditure have on childbearing. Since most demographic data are inadequate to be considered for the examination of the relationship that income and expenditure have with fertility it is difficult to know the magnitude of the effects of the two on fertility. The lack of economic data in most demographic surveys also implies that studies on factors affecting South African fertility do not adequately investigate the impact that these factors have on South African fertility as differences in most of these factors are greatly affected by economic factors.

The results suggest that implementation of the South African population policy has to be harmonised with other policies that seek to reduce inequalities in well-being of South Africans if racial differentials in fertility are to be addressed. The success of the policy will depend on how much other policies will perform in wealth distribution and women's empowerment.

6 REFERENCES

Agresti, A. 2002 *Categorical Data Analysis*. New Jersey: John Wiley & Sons, Inc.

Ainsworth, M. 1996. "Introduction: Fertility in Sub-Saharan Africa". *The World Bank Economic Review,* **10**(1): 81-84.

Amin, S., Casterline, J. B. & Spess, L. 2007. *Poverty and Fertility: Evidence and Agenda*. New York: Population Council.

Argent, J. 2009. *Household Income: Report on NIDS Wave 1*. Cape Town: University of Cape Town, SALDRU.

Argent, J., Finn, A., Leibbrandt, M. & Woolard, I. 2009. *Poverty: Analysis of the NIDS Wave 1 Dataset*. Cape Town: University of Cape Town, SALDRU.

Bongaarts, J. 1982. "The Fertility-Inhibiting Effect of Intermediate Fertility Variables". *Studies in Family Planning,* **13**(6/7): 179-189.

Bongaarts, J. 1985 "The Fertility-Inhibiting Effects of the Intermediate Variables," in Hill, A. G. & Brass, W. (Eds.) *The Analysis of Maternity Histories*. Liege: Ordina Editions for IUSSP.219-241

Bongaarts, J. 1987. "The Proximate Determinants of Exceptionally High Fertility". *Population and Development Review,* **13**(1): 133-139.

Bongaarts, J., Frank, O. & Lesthaeghe, R. 1984. "The Proximate Determinants of Fertility in Sub-Saharan Africa". *Population and Development Review,* **10**(3): 511-537.

Bongaarts, J. & Potter, R. G. 1983 *Fertility, Biology, and Behavior: An Analysis of the Proximate Determinants*. New York: Academic Press.

Caldwell, J. C. 1980. "Mass Education as a Determinant of the Timing of Fertility Decline". *Population and Development Review,* **6**(2): 225-255.

Caldwell, J. C. & Caldwell, P. 1993. "The South African Fertility Decline". *Population and Development Review,* **19**(2): 225-262.

Caldwell, J. C., Orubuloye, I. O. & Caldwell, P. 1992. "Fertility Decline in Africa: A New Type of Transition?" *Population and Development Review,* **18**(2): 211-242.

Chimere-Dan, O. 1993. "Population-Policy in South-Africa". *Studies in Family Planning,* **24**(1): 31-39.

Cochrane, S. H. 1979 *Fertility and education: What do we really know?* Baltimore: The John Hopkins University Press.

Davis, K. & Blake, J. 1956. "Social Structure and Fertility: An Analytic Framework". *Economic Development and Cultural Change,* **4**(3): 211-235.

Department of Health. 2002. *South Africa Demographic and Health Survey: Final Report*. Pretoria: Department of Health.

Dickson, K. E., Jewkes, R. K., Brown, H., Levin, J., Rees, H. & Mavuya, L. 2003. "Abortion Service Provision in South Africa Three Years After Liberalization of the Law". *Studies in Family Planning,* **34**(4): 277-284.

Doctor, H. V. & Simelane, S. E. 2005. "The Impact of Living Standards on Childhood Mortality in South Africa: Evidence From Cross-Sectional Data". *Journal of Social Development in Africa,* **20**(2): 7-38.

Dorrington, R., Timaeus, I. M., Moultrie, T. A. & Nannan, N. 2004. "Estimates of Provincial Fertility and Mortality in South Africa, 1985-1996". *Southern African Journal of Demography,* **9**(2): 25-57.

Filmer, D. & Pritchett, L. 1999. "The Effect of Household Wealth on Educational Attainment: Evidence from 35 Countries". *Population and Development Review,* **25**(1): 85-120.

Filmer, D. & Pritchett, L. 2001. "Estimating Wealth Effects Without Expenditure Data - or Tears: An Application To Educational Enrollments In States Of India". *Demography,* **38**(1): 115-132.

Finn, A., Franklin, S., Keswell, M., Leibbrandt, M. & Levinsohn, J. 2009. *Expenditure: Report on NIDS Wave 1*. Cape Town: University of Cape Town, SALDRU.

Garenne, M., Tollman, S., Kahn, K., Collins, T. & Ngwenya, S. 2001. "Understanding Marital and Premarital Fertility in Rural South Africa". *Journal of Southern African Studies,* **27**(2): 277-290.

Harwood-Lejeune, A. 2001. "Rising Age at Marriage and Fertility in Southern and Eastern Africa". *European Journal of Population,* **17**(3): 261-280.

Jewkes, R. K., Gumede, T., Westaway, M. S., Dickson, K., Brown, H. & Rees, H. 2005. "Why are women still aborting outside designated facilities in metropolitan South Africa?" *BJOG: An International Journal of Obstetrics & Gynaecology,* **112**(9): 1236-1242.

Kaufman, C. E. 1998. "Contraceptive Use in South Africa under Apartheid". *Demography,* **35**(4): 421-434.

Kaufman, C. E. 2000. "Reproductive Control in Apartheid South Africa". *Population Studies,* **54**(1): 105-114.

Kirk, D. 1996. "Demographic Transition Theory". *Population Studies,* **50**(3): 361-387.

Kirk, D. & Pillet, B. 1998. "Fertility Levels, Trends, and Differentials in Sub-Saharan Africa in the 1980s and 1990s". *Studies in Family Planning,* **29**(1): 1-22.

Kravdal, O. 2001. "Main and Interaction Effects of Women's Education and Status on Fertility: The Case of Tanzania". *European Journal of Population,* **17**(2): 107-136.

Kravdal, O. 2002. "Education and Fertility in Sub-Saharan Africa: Individual and Community Effects". *Demography,* **39**(2): 233-250.

Leibbrandt, M., Woolard, I. & de Villiers, L. 2009. *Methodology: Report on NIDS Wave 1*. Cape Town: University of Cape Town, SALDRU.

Moultrie, T. & Dorrington, R. 2009. *Demography: Analysis of the NIDS Wave 1 Dataset*. Cape Town: University of Cape Town, SALDRU.

Moultrie, T. A. & Dorrington, R. 2004. *Estimation of fertility from the 2001 South African Census data*. Cape Town: University of Cape Town, Centre for Actuarial Research.

Moultrie, T. A. & McGrath, N. 2007. "Teenage fertility rates falling in South Africa". *South African Medical Journal,* **97**(6): 442-443.

Moultrie, T. A. & Timaeus, I. M. 2003. "The South African fertility decline: Evidence from two censuses and a Demographic and Health Survey". *Population Studies,* **57**(3): 265-283.

Nguyen-Dinh, H. 1997. "A Socioeconomic Analysis of the Determinants of Fertility: The Case of Vietnam". *Journal of Population Economics,* **10**(3): 251-271.

Palamuleni, M., Kalule-Sabiti, I. & Makiwane, M. 2007 "Fertility and Childbearing in South Africa," in Amoateng, A. Y. & Heaton, T. B. (Eds.) *Families and Households in Post-Apartheid South Africa: Socio-Demographic Perspectives.* Cape Town: Human Sciences Research Council Press.113-133

Rodriguez, G. & Cleland, J. 1988. "Modelling Marital Fertility by Age and Duration: An Empirical Appraisal of the Page Model". *Population Studies,* **42**(2): 241-257.

Sibanda, A. 1999. "Reproductive change in Zimbabwe and Kenya: The role of proximate determinants in recent fertility trends". *Biodemography and Social Biology,* **46**(1): 82-99.

Sibanda, A. & Zuberi, T. 2005 "Age at first birth," in Zuberi, T., Sibanda, A. & Udjo, E. O. (Eds.) *The Demography of South Africa.* New York: M.E. Sharpe, Inc.65-89

Singh, S., Casterline, J. B. & Cleland, J. G. 1985. "The Proximate Determinants of Fertility: Sub-national Variations". *Population Studies,* **39**(1): 113-135.

Swartz, L. 2002. "Fertility Transition in South Africa and its Implications on the Four Major Population Groups," Fertility and the Current South African Issues of Poverty, HIV/AIDS and Youth. Pretoria, 22 October, 2002. http://www.un.org/esa/population/publications/completingfertility/RevisedSwartzpaper.PDF. Retrieved on 4/01/2011

Thomas, D. 1999 "Fertility, Education and Resources in South Africa," in Bledsoe, C. H., Casterline, J. B., Johnson-Kuhn, J. A. & Haaga, J. G. (Eds.) *Critical Perspectives on Schooling and Fertility in the Developing World.* Washington, D.C: National Academy Press

Udjo, E. O. 2001. "Marital patterns and fertility in South Africa: the evidence from the 1996 population census," The International Union for the Scientific Study of Populations; 2001. Salvadore, Brazil, 18-24 August 2001. http://www.iussp.org/Brazil2001/s40/S43_P01_Udjo.pdf. Retrieved on 25/01/2011

Udjo, E. O. 2003. "A Re-Examination of Levels and Differential in Fertility in South Africa From Recent Evidence". *Journal of Biosocial Science,* **35**(-): 413-431.

Warren, C. W., Johnson, J. T., Gule, G., Hlophe, E. & Kraushaar, D. 1992. "The Determinants of Fertility in Swaziland". *Population Studies,* **46**(1): 5-17.

Wittenberg, M. 2009. *Weights: Report on NIDS Wave 1*. Cape Town: University of Cape Town, SALDRU.

Zwang, J. & Garenne, M. 2008. "Social Context of Premarital Fertility in Rural South-Africa". *African Journal of Reproductive Health,* **12**(2): 98-110.