The AIDS Transition: impact of HIV/AIDS on the demographic transition of black/African South Africans by 2021

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Abstract

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The first two official AIDS cases were diagnosed in South Africa in 1982. During the same period of the 1980s, the black/African population was experiencing an accelerated fertility decline, following a period of accelerated mortality decline. Demographers invoked the demographic transition theory to explain the observed mortality and fertility decline. According to the demographic transition theory, mortality and fertility rates would continue declining to low, post transitional levels with increasing modernization.
The relatively higher prevalence of HIV/AIDS estimated among black/African South Africans is expected to alter their demographic transition. This research investigates the impact of HIV/AIDS on the demographic transition of black/Africans by 2021.

Projections of mortality and fertility rates were obtained from runs of the ASSA2002 model, an AIDS demographic model of the Actuarial Society of South Africa (ASSA). Projections of the UNDPs Human Development Index (HDI) were taken as a measure of modernization. HIV/AIDS is projected to alter the demographic transition of the black/African population therefore a more appropriate term was introduced: the AIDS transition.

The AIDS transition is characterized by increased mortality levels similar to levels observed in the black/African population in the 1950s, with an accelerated fertility decline. A reversal of more than a decade in levels of human development is also expected. The AIDS transition is paradoxical, as one of the identifiers of modernization is attained in the form of fertility decline whilst an indicator of a reversal in modernization will be attained in the form of mortality incline.

November 2004

Declaration

I declare that *The AIDS Transition: impact of HIV/AIDS on the demographic transition of black/African South Africans by 2021* is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Sandra Dzidzai Matanyaire November 2004

Signed:

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Chapter one

Introduction

1.1 HIV/AIDS and the demographic transition in South Africa

The first two official AIDS cases were diagnosed in South Africa in 1982 (Whiteside and Sunter 2000: 47). AIDS is an acronym for Acquired Immune Deficiency Syndrome, the final disease manifestation from infection by the Human Immunodeficiency Virus (HIV). HIV belongs to a family of retroviruses within the subgroup of lentivirus. Retroviruses (*Retroviridae*) contain a unique enzyme: reverse transcriptase, which facilitates the formation of a copy of the host cell DNA when the retrovirus enters a cell. The copy of the DNA then physically integrates with the host cell DNA and directs the manufacture of required proteins. Lentiviruses are retroviruses that are slow in manifesting disease ('lenti' means slow in Greek), resulting in a lag from infection, to morbidity, to death (Schoub 1994: 55-56).

Two types of HIV are known to cause AIDS: HIV-1 and HIV-2. HIV-1 has three groups: the main group M, the outlier group O and group N (Barin *et al* 2002: 161). Group M viruses cause the majority of HIV infections in the world and this group is further divided into 10 subtypes from subtype A to subtype J (Renjifo and Essex 2002: 268). In South Africa, subtype C of the HIV-1 group M is the most prevalent, with over 95% of the HIV infections in South Africa thought to be subtype C infections (Morris *et al* 2000: 339).

Once HIV infection occurs, the virus attacks two main types of white blood cells: CD4 cells referred to also as T-helper lymphocytes and monocytes and macrophages. T-helper cells play a central role in controlling the immune system by functioning as regulators for the immune system. Monocytes and macrophages get rid of foreign proteins in the body by ingesting them and presenting them to the immune system to mount a response against the foreign proteins (Schoub 1994: 24). HIV infection therefore results in the gradual and progressive impairment of the human immune system resulting in the emergence and recurrence of a variety of infections commonly referred to as opportunistic infections (Palloni 1996: 4).

HIV can be transmitted through transfusion of HIV infected blood or administering HIV infected blood products; vaginal, oral or anal sexual intercourse with an infected partner; mother-to-child transmission either intrauterine, perinatally or through breastfeeding and through intravenous injection with HIV contaminated needles, syringes or sharp objects (Schoub 1994: 91-120, Palloni 1996: 4).

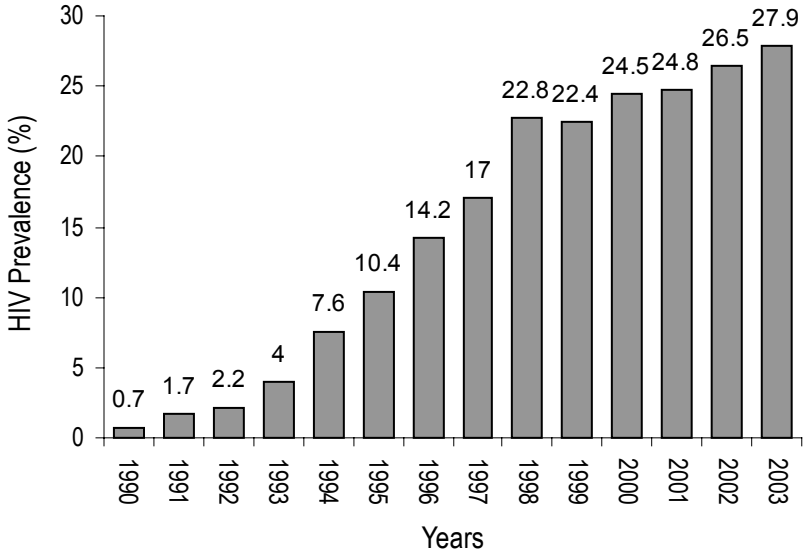
When HIV/AIDS emerged in South Africa (officially), mortality and fertility rates were declining within the South African population. Demographers had already invoked the demographic transition theory to explain the fertility and mortality decline. According to the demographic transition theory populations move from levels of high mortality and high fertility with increasing modernity, to post transitional levels characterized by low mortality and low fertility. Modernity is associated with processes like urbanization, industrialization, economic development and socio-economic development. Variations however existed in the pace of mortality and fertility decline across the four population groups in South Africa: black/African, Indian/Asian, Whites and Coloureds (Mostert *et al* 1998: 15-16). Although these population group classifications were used in the apartheid era, this research does not purport to continue with the segregatory and discriminatory purpose for which the population groups were used in the past. Reference to the population groups is purely for academic purposes. The black/African population began their demographic transition at a later stage compared to other population groups in South Africa.

Consequently at the start of the HIV/AIDS pandemic the black/African population had entered a period of accelerated fertility decline although fertility decline had began in the 1960s (Moultrie and Timæus 2002: 27). Levels of mortality had been declining since 1945 from levels of 23.4 per 1000 to 9.1 per 1000 of the population in 1980 (Mostert *et al* 1998: 76). Mortality and fertility rates were expected to continue declining to post transitional levels, as the black/African population progressed through their demographic transition.

Twenty years after its inception, AIDS has become the single leading cause of death in South Africa, accounting for 30% of all deaths (Bradshaw *et al* 2003: 31). The Department of Health has been conducting national sentinel surveys since 1990 of pregnant women

attending public antenatal clinics (ANC) for the first time to determine the prevalence of HIV (Figure 1.1). HIV prevalence among antenatal attendees increased almost exponentially from 0.7% in 1990 to 27.9% in 2003.

Figure 1.1: HIV prevalence among antenatal clinic attendees in South Africa: 1990-2003



Source: Department of Health (2004: 6)

The antenatal clinic survey results should however, be considered in the light of the following limitations (Boerma, Ghys and Walker 2003: 1929):

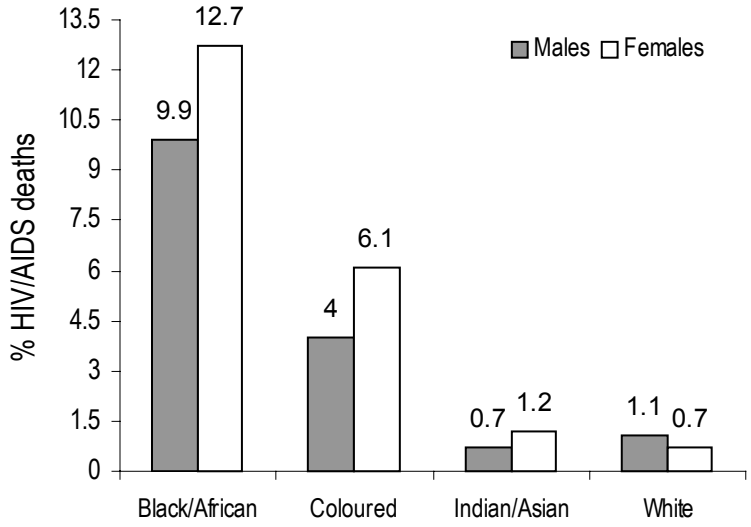
i. The representativeness of pregnant women who attend public antenatal clinic of all pregnant women as the survey only captures data on public clinics
ii. The bias introduced from reduced fertility due to biological effects in HIV-1 infected women
iii. Under representation of smaller rural sites.

The Nelson Mandela/Human Sciences Research Council (HSRC) study of HIV/AIDS conducted in 2002 showed a prevalence rate of 12.9% (11.2-14.5) for the black/African population compared with 6.2% (3.1-9.2) for the Whites, 6.1% (4.5-7.8) for the Coloureds and 1.6% (0-3.4) for the Indian/Asians. The study however excluded children under the age

of 2 years and was prone to limitations of a socio-behavioural study including moderate participation rates and recall biases by respondents (HSRC 2002: 31-32).

A study on the causes of death in South Africa for the period 1997 to 2001 revealed that the black/African population experienced the largest relative percentage of HIV/AIDS deaths across the four population groups with males experiencing 9.9% and females 12.7%. The lowest male and female percentage of AIDS deaths was 0.7% occurring among the Indian/Asian and White populations (Figure 1.2).

Figure 1.2: Percentage of HIV/AIDS deaths for each population group and sex: 1997- 2001



Source: Statistics South Africa (2002: 17, 19)

The Nelson Mandela/HSRC study and the causes of death study both indicate that the black/African population is the hardest hit by the HIV/AIDS pandemic in South Africa. Some of the reasons attributed to the high prevalence among the black/African population include the migrant labour system, and the forced removals and relocations as a result of past apartheid policies (HSRC 2002: 59).

Contrary to expectations of the demographic transition theory, HIV/AIDS is increasing mortality rates. Furthermore, HIV/AIDS is expected to accelerate the declining fertility rates

through (a) deaths of women in reproductive years (b) reduced coital frequency due to AIDS related illnesses (c) reduced spermatozoa production (d) co-infection of HIV/AIDS with other sexually transmitted infections (STIs) that reduce fecundity (e) foetal loss among HIV positive women (f) weight loss resulting in amenorrhoea (Du Plessis 2003: 83). A Department of Health (1999) publication of maternal deaths in South Africa in 1998 showed that over 87% of the women who died of AIDS had less than three deliveries and 74% of those women were below 30 years of age. Paradoxically the impact of HIV/AIDS is expected to decline fertility, an 'accomplishment' of the demographic transition theory.

At the formulation of the demographic transition theory, the possibility of a gigantic, incurable pandemic like HIV/AIDS had not been anticipated. Hence no demographic transition model incorporates the effects of HIV/AIDS. Omran (1998: 100) however in stating epidemiological transition dynamics notes that the "Flow of the [epidemiological] Transition can be disrupted or reversed under crises or the Transition may accelerate under strikingly favourable conditions". Omran refers to HIV/AIDS as one of the health burdens in 'non-western' populations. The epidemiological transition is encompassed in the demographic transition. Furthermore, Shell (1998) argues:

> The effects of such epidemics as HIV/AIDS which will only bite deeply into the cohorts in the next century…might retard the demographic transition since the demographic transition has historically been preceded by a drop in mortality. Since AIDS is a comparatively recent pandemic for human populations, little work has been directed to its overall effect on the long-term process of the demographic transition (1998:7).

A gap therefore exists between the theoretical demographic transition and the observed or expected demographic transition especially in high HIV prevalence populations like the black/African South Africans.

1.2 Research problem

To project the impact of HIV/AIDS on the demographic transition of the black/African population in South Africa and if the effects are large enough, to determine whether reference can be made to a new type of transition: the AIDS transition.

1.3 Research question

To what extent will the HIV/AIDS pandemic alter the demographic transition of the black/African population in South Africa?

1.4 Aims and scope

The study aims to:

i. Alter the traditional demographic transition model to incorporate the effect of HIV/AIDS for the black/African population in South Africa.
ii. Introduce a new terminology more relevant in the era of HIV/AIDS: the AIDS transition model.
iii. Project implications of the AIDS transition on the demographic transition of the black/African population.

The scope of the study will be limited to the black/African South African population, with population estimates projected to the year 2021.

1.5 Motivation for study

Research will be limited to the black/African population due to the relatively higher HIV prevalence within that population. Estimated at 79% of the total South African population (Statistics South Africa 2003: 13), the demographic position of black/Africans will affect the demography of South Africa significantly, therefore the impact of HIV/AIDS on their demographic transition merits study. Furthermore, at the start of the HIV/AIDS pandemic the black/African population was in an earlier stage of the demographic transition relative to other population groups in South Africa.

Studies on the impact of HIV/AIDS have tended to be either from a demographic perspective or an economic or socio-economic perspective. HIV/AIDS is affecting demography, social and economic development of populations simultaneously, hence the need for a platform that allows simultaneous investigation. As the demographic transition

theory links demographic, social and economic factors, an interrelated impact analysis can be conducted.

1.6 Assumptions

The main assumptions of the study are that:

i. The demographic transition model is applicable to the black/African population in South Africa.
ii. Population projections of the ASSA2002 and those produced by the author provide a reasonable view of the black/African population.
iii. No HIV/AIDS cure is supposed for the length of study until the year 2021.

1.7 Limitations of study

i. Limitations of population projections in making assumptions on human behaviour and forecasting demographic rates.
ii. Aggregating the study across South African provinces that exhibit varying HIV prevalences.
iii. Combining rural and urban black/Africans in varying stages of the demographic transition.

1.8 Research method

The ASSA2002 model of the Actuarial Society of South Africa (ASSA) was selected to project the impact of HIV/AIDS on the demographic transition of the black/African South Africans. The ASSA2002 model is an AIDS demographic model of the Actuarial Society of South Africa (ASSA). The AIDS Committee of the Actuarial Society of South Africa (ASSA) released earlier models, namely: ASSA500 in 1996, ASSA600 in 1999, ASSA2000 in 2001 with the latest release being the ASSA2002 released in 2004. The ASSA2002 model produces population projections as at 1 July of each respective year starting from 1985.

The impact of HIV/AIDS on mortality and fertility rates by 2021 will be obtained from forward projections run from the ASSA2002 model. Population projections of the ASSA2002 model will also be used as a basis (where appropriate) in determining the impact of HIV/AIDS on modernization. The projections of mortality, fertility and modernization will determine the overall impact of HIV/AIDS on the demographic transition.

The ASSA2002 model was selected for this research based on the following:

i. The model allows for the four general population groups in South Africa to be modelled separately
ii. The ASSA2002 model is an AIDS demographic model, hence it models HIV/AIDS into population rates simultaneously
iii. The model allows modelling assumptions to be changed by the user and hence the effects of varying assumptions made by the ASSA AIDS Committee can be studied.
iv. Projections of the ASSA2002 model are widely used and quoted in South Africa

1.9 Thesis outline

This section has introduced HIV/AIDS in South Africa, concluding that HIV is more prevalent in the black/African population. Mortality and fertility rates of the black/African population were declining at the inception of the pandemic with rates expected to continue declining as the population progressed through their demographic transition. However, HIV/AIDS is expected to affect their transitional progress, thus motivating this study on the impact of HIV/AIDS on the demographic transition of the black/African.

The demographic transition theory will be reviewed in chapter two. The conception and evolution of the demographic transition theory is discussed chronologically in the first section. The various critics of the theory will be highlighted, mainly causality factors of the fertility decline. A statement of the demographic transition theory will follow leading to a discussion of the applicability of the demographic transition theory to the South African population, particularly the black/African population.

In chapter three assumptions of the impact of HIV/AIDS on elements of the demographic transition theory: mortality rates, fertility rates and modernization, will be discussed. Some key assumptions of HIV modelling of the ASSA2002 model are discussed, as projections of mortality and fertility rates will be obtained from the model. The UNDP's Human Development Index (HDI) will be used as a measure of modernization. The projected impact of HIV/AIDS on the human development index will be discussed and assumptions stated.

Results of projections of HIV/AIDS, mortality rates, fertility rates and the human development index are provided in chapter four. Population projections will show the impact of HIV/AIDS estimated on the black/African population by 2021. Mortality rates will be increased, fertility decline will be accelerated and modernization levels as measured by the human development index will be reduced and retarded from the impact of HIV/AIDS. It will be shown and suggested in chapter four that perhaps reference to an AIDS transition is more appropriate and relevant due the higher prevalence of HIV/AIDS among the transitional black/African population.

Chapter five discusses the demographic implications of the AIDS transition. Age and sex population structure of the black/African population in 2021 and the implications of either a second demographic transition or a continuation of the disrupted transition after the AIDS transition will be discussed.

Chapter six concludes this research with a summary of the main points raised in the five preceding chapters and aspects for further study will be provided.

Chapter two

The demographic transition theory

2.1 Introduction

> In traditional societies, fertility and mortality are high. In modern societies, fertility and mortality are low. In between there is demographic transition (Demeny 1972: 153).

Following a discussion of HIV/AIDS and its emergence during a period of demographic transition, literature on the demographic transition will be reviewed in this section. The literature review will not cover economic theory perspectives of the transition theory (Coale and Hoover 1958, Easterlin 1978). A historical account of the theory will be provided, leading to a statement of the early demographic transition theory and criticisms which followed. The present day demographic transition theory will be provided with the concluding section discussing the demographic transition in South Africa, particularly the black/African population.

2.2 Literature review

The origin of the demographic transition theory can be traced to articles published by Landry (1909, 1934), Thompson (1929) and Notestein (1945). Notestein is considered to have formulated the demographic transition theory in its present day form, although his was not the first statement of the theory (Kirk 1996: 361).

Writing before world war one, Adolphe Landry's earlier work refers to three regimes of population development: primitive, intermediate and modern. Landry published a study in 1909 and a later edition in 1934 entitled *Les trois théories principales de la population.* In 1934, Landry also published an article entitled *La révolution démographique* (Landry 1987: 731).

Landry (1987: 736) describes the primitive regime as "…characteristic of all living beings other than man, although it has been characteristic of man in the past and can still be

found". Birth rates are not limited by any economic factors but by factors like the procreative ability of individuals and the age at marriage. Populations in the primitive regime are in equilibrium as a result of mortality rates equalling or fluctuating around fertility levels.

In the intermediate regime, economic factors reduce fertility levels through aspirations of individuals for a certain standard of living for themselves and their families. Celibacy and delayed age at first marriage are employed to prevent the lowering of lifestyle (Landry 1987: 737). If medical advances coupled with technological progress take place, productivity will be increased resulting in population growth. Landry cites the populations of France and England, which grew in the intermediate stage.

The modern regime is characterized mainly by a higher standard of living and a widespread use of birth control. Fertility decline is the main determinant of population change and Landry explains this fertility decline with 'selfish feelings' that were becoming dominant: (a) children being seen as an expense and an inconvenience (b) children getting in the way of their mother's career and of their parent's pleasures and travel (1987: 739). Laundry refers to the prospect of depopulation in the modern regime, "Where, then, will we stop on the downward slope of fertility…the prospect of depopulation looms…" (1987: 739). The modern regime is evident at present in developed countries experiencing fertility levels below the replacement level.

Landry wrote of a demographic revolution being experienced in Europe that would become widespread throughout the world. The demographic revolution was a result of improvements in material conditions due to progress achieved in technology, medicine and hygiene.

On the eve of the great depression in 1929, Warren Thompson published an article entitled *Population*. Thompson also believed that changes in population growth would influence the future history of mankind (1929: 959). However Thompson did not refer to Landry. In his article, Thompson classified countries into three main groups according to their birth rates and death rates:

Group A: Western Europe, Australia, United States of America and Canada
Group B: Italy, Spain and the Slavic Countries of Central Europe
Group C: Russia, Japan, India and countries from Africa, Asia, and South America.

Group A was characterised by countries with rapidly declining birth and death rates. Birth rates were declining at a faster pace than death rates. According to Thompson, group A populations had progressed from high growth to low growth and would become stationary and start declining in numbers. France was noted as an exception to group A countries because of its more rapidly declining death rates compared to birth rates (1929: 967).

Group B countries had declining death and birth rates, with death rates declining the same or more rapidly than fertility rates. Thompson (1929: 969), states that the condition of countries in group B was identical to group A countries thirty to fifty years earlier although birth rates in group B were likely to decline faster than in group A. Thompson attributed the rapidity of birth rate decline to the speed of industrialization (1929: 970)

Countries in group C had high birth rates and high death rates. With the exception of Japan and India, Thompson had no data for the other countries and thus made estimations on these populations: "But when these C countries are compared with A and B countries, we are fully justified in assuming that in the former neither births or deaths have come under voluntary control to anything like the same extent that they have in the latter" (1929: 971).

Neither Thompson nor Landry refer to the term demographic transition. Nevertheless, Thompson implies a progression of populations from group C to group A, a characteristic similar to the progression through the demographic transition model.

Near the end of world war two, Frank Notestein published a seminal article entitled *Population: The long view*. Notestein (1945) did not make reference to earlier articles by Landry (1909, 1934) or Thompson (1929). In his article, Notestein distinguishes three types of population change or demographic types: incipient decline, transitional growth and high potential growth. His formulation of the three demographic types was based on the observations that (a) during the last three centuries world population had been growing at a rapid and accelerating pace (b) the rapid growth had been particularly evident in Europe and

overseas especially prior to 1900 (c) since 1900 population growth tended to decline in Europe, North America and Oceania whereas in Africa, Asia, Central and South America there was acceleration in growth.

Type one populations experiencing incipient decline are characterised by low mortality and low fertility. Fertility levels are either below or approaching the replacement level of 2.1 children per average woman. Notestein (1945: 42) cites North America, Australia, New Zealand, and north-western, southern and central Europe as countries experiencing incipient decline.

Transitional growth, the second demographic type, is characterised by declining fertility and mortality levels. Mortality decline precedes fertility decline and this difference in the timing of declines causes rapid population growth. According to Notestein (1945: 39) the decline in mortality "…arose from different sources and occurred in different degrees in various parts of the world." He attributes modernization for the rise in standards of living and control of diseases through peace and domestic order in Europe; agricultural innovations that increased food supply, the industrial revolution, sanitary and medical advances.

Fertility was slower to respond to modernity than mortality thus fertility decline was subsequent to the decline in mortality during transitional growth. Notestein (1945: 39) also mentions religious factors, moral codes, laws, education, community customs, marriage practices, and family organisations as factors maintaining high levels of fertility. The decline in high fertility levels was a gradual process. Fertility eventually declined, "…largely by means of contraception, but in response to drastic changes in the social and economic setting that radically altered the motives and aims of people with respect to family size" (Notestein 1945: 40). The populations of Eastern Europe were at the end of the stage, the former Soviet Union, Japan and some Latin American countries were in mid-course, whilst Palestine, Turkey and parts of North Africa were in the early stages of transitional growth.

Type three countries of high potential growth populations are yet to enter the transitional growth period. Pre-modern levels of high mortality and high fertility levels prevail in countries of this demographic type. These countries include Egypt, central Africa, much of

the Middle East, all of Asia except for the former Soviet Union and Japan, the Pacific and Caribbean islands, and much of Central and South America.

Notestein's demographic 'prototypes' are the basis for the early formulation of the demographic transition theory. The early demographic transition theory was a three-staged model with a pre-transitional stable population characterised by high mortality and high fertility in the first stage. Mortality rates decline initially which, coupled with high rates of fertility, result in rapid population growth. Fertility subsequently declines during the transitional stage, to fluctuate around relatively low stable levels of mortality in stage three of the transition. Economic development, industrialisation, and modernization are processes Landry, Thompson and Notestein respectively associated with the demographic transition. However HIV/AIDS is expected to disrupt the envisaged flow of transition in high prevalence populations like the black/African South Africans.

The demographic transition theory has been criticised in applicability to non-western populations as its formulation stemmed from historical accounts of 'western' demographic trends. Perhaps one of the notable dismissive quotes regarding the demographic transition is the following quote from Goldscheider:

> Suffice it to say that despite the general temptation of viewing demographic history through the lens of demographic transition theory, the theoretical, methodological and empirical inadequacies associated with these hypothesized relationships render the theory virtually useless analytically (1971: 14).

In an introduction to *The Study of Population*, Hauser and Duncan also question the demographic transition theory:

> However the influences on population growth that it postulates are closely bound up with the particular historical circumstances of population growth in Western countries. Hence there is a big question as to whether it can provide more than vague, general suggestions about the factors likely to govern growth in the future. Because the theory is an attempt to generalize from a particular body of historical facts, it raises in perhaps the clearest form the issue of "historicism", i.e., that of whether such generalizations can successfully be applied to new situations (1959: 14).

Habakkuk on *Population Growth and Economic Development since 1750* states that:

> This concludes what I have to say about the population history of Europe. If this interpretation is broadly correct, it is evident that Western demographic experience is not a secure guide to future population change in the underdeveloped regions of the contemporary world (1972: 84).

Nevertheless, subsequent to the demographic transitions of the 'western' countries, mortality and fertility declines in 'non-western' populations have proved the validity of the transition theory. As Kirk (1996: 367) noted, "When transition theory is applied to the experience in non-European countries, the regularities are impressive. In every instance mortality has declined first and has been followed by declining fertility…." Notestein *et al* noted, "Few social trends in the modern period have been as universal and persistent as the decline of mortality and fertility" (1944: 16).

Differences were nonetheless exhibited between demographic transitions of 'western' and 'non-western' countries related to: the pace at which mortality declined, the rapidity of population growth, social and economic conditions (modernity levels) that prevail during the demographic transition, the length of the transition process, pre-transitional and post-transitional mortality and fertility levels (Coale 1973: 68-69, Caldwell 1976: 328, Srinivasan1986: 172-173, Teitelbaum 1987: 31, Ziehl 2002: 29). However, populations experience the demographic transition under variable social, economic, cultural, traditional, linguistic and political circumstances bringing about variations in the transition process. The important point is that the demographic transition is attained across cultures. As Kirk (1996: 386) noted, "They may accelerate or delay the transition, but the transition itself is inescapable".

To date, demographic transition theorists do not incorporate the likelihood of a reversal or interruption of the expected unidirectional flow of mortality and fertility rates. Omran (1998: 100) includes the possibility of a reversal or acceleration in the epidemiological model, a feature lacking in the transition model. HIV/AIDS is expected to simultaneously reverse the decline in mortality and accelerate fertility, therefore the need to highlight the likelihood of the pandemic on the demographic transition model.

Most probably the main criticism of the demographic transition theory is its failure to incorporate the role of international migration in determining population growth (Goldscheider 1971: 14, Teitelbaum 1987: 32; Ziehl 2002: 30). Substantial international migration can either moderate the effects of population growth or accelerate growth. The emigration of millions of Europeans to the 'new world' in the nineteenth century alleviated problems of population growth in Europe (Teitelbaum 1987: 32). In particular Ireland quoted as "the only country that can truthfully be said to have resolved a problem of acute overpopulation by mass emigration" (Notestein *et al* 1944: 60). In the present day however, defined country borders and international migration laws control international migration thus largely diminishing the role of international migration in affecting population growth significantly. The overall effects of international migration are also reduced by simultaneous emigration and immigration.

Modernization is attributed as the cause of mortality and fertility decline. The term modernization is however too vague as it encompasses several processes. In early formulations of the transition theory economic factors were largely associated with the demographic transition Kirk (1996: 369). According to Beaver (1975: 4) the demographic transition is associated with the process variously known as modernization, development, socio-economic development, industrialization, bureaucratisation or urbanisation. Teitelbaum (1987: 29) notes that the stages of the demographic transition are derived from the "…fundamental economic and social changes of 'development' of 'modernization'". The United Nations (2002: 2) describe modernization as a result of industrialization, urbanization, education, empowerment of women, and substantial socio-economic development. Srinivasan states that:

> In simple terms 'modernisation', connotes the process by which a traditional-bound agrarian society of very low levels of per capita income, health, education, status of women and welfare, gets transformed into an industrial society with a large proportion of the population living in the urban areas, with a high level of income, expectation of life, literacy and education and other concomitant social changes specially relevant to the improvement of the status of women in the society (1986: 171).

However Goldscheider cautions that the use of modernization as a general term avoids specifying the particular and significant features of modernization effecting population change:

> Modernization is not synonymous with all social change; it does, however, cover the most visible, large-scale structural and cultural social changes that have engulfed significant segments of the world…However, because modernization includes an enormous range of changes-social, economic, political, cultural, and personal-we must be wary of not to end up connecting every change to demographic processes (1971: 79-80).

Modernization will be considered as a general term associated with processes like industrialization, urbanization, education, social development and economic development in the general discussion of the demographic transition theory. The result of these processes includes increased life expectancy, improved standards of living, increased literacy and empowerment of women. However the specific processes of modernization associated with the demographic transition of the black/Africans will be specified in a later section.

Modernization has been sufficiently accepted in explaining mortality decline. Debates on the mortality decline have been limited mainly to identifying the most significant factors.
Causality of fertility decline in contrast has been a widely debated issue. Kirk (1996: 373) attributes the debates of fertility decline on the emphasis given to socio-economic or modernization factors by American authors, although they made reference to other factors as well.

Caldwell (1976), questions the validity of 'modernization' in explaining the fertility decline of 'Third World' countries. Using the Ibadan society of Nigeria as an example of a transitional society, Caldwell attributes 'Westernization' as the cause for the fertility transition. Westernization brought about from importing 'western' values and manners. The agents of westernization are noted as "mass schooling" and "mass media" which bring about "mass infusion of European manners" (Caldwell 1976: 353). Caldwell implies an interchange in the causality and instead of modernization effecting fertility change rather fertility decline effects modernization.

Caldwell's restatement of a demographic transition achieved through communication tools (mass media and mass schooling) corresponds with diffusion-based theories of fertility decline. Theories of diffusion attribute the spread and dissemination of information and new ideas as the cause for the decline in fertility (Carlsson 1966, Rogers 1995). New ideas and skills spread from the pioneers who adopt them first, and are then spread or diffused into the rest of the population (Coale 1973: 67). Palloni (2001) on diffusion models states:

> In diffusion models, the behaviour "spreads" and is adopted by individuals irrespective of their socio-economic positions, even among those whose social or economic positions are hypothetically associated with cost-benefit calculations that do not necessarily require the new behaviour (2001: 68).

Furthermore Casterline notes that:

> …What sets diffusion explanations apart…is the assertion that fertility decline is not simply an adaptive response to changes in demographic, economic, and social structures; rather, it reflects the spread of certain key attitudes (e.g., about the costs and benefits of children) and behaviours (e.g., birth control technologies) (2001: 3).

Therefore diffusion theories explain observed fertility transitions in populations without significant modernization, for instance in Bangladesh, fertility declined from a total fertility rate of seven children per woman to nearly 3.5 children per woman in thirty years without meeting economic development or large scale industrialization goals (Palloni 2003: 238). Moreover the pace of fertility decline in demographic transitions in some non-European countries has prompted Kirk (1996: 377) to state that if the diffusion assumption is omitted it would, "…be difficult-if not impossible-to explain the rapidity and pervasiveness of fertility declines". Diffusion processes can however, work in the reverse way with individuals resisting new ideas or rejecting them (Palloni 2001: 68).

Cultural factors have been also attributed to contribute to the process of fertility decline. Lesthaeghe (1983: 431) argues that one of the dimensions of modernization is the shift from 'group orientation' to 'individual orientation'. The changing of traditionally kinship based family systems to 'individualistic' based family systems and the secularism of individuals. Landry in his 1934 publication attributes 'selfish feelings' (synonymous with individuality) as the reason for widespread fertility decline (1987: 739).

The role of government has been identified as an important factor in influencing the both fertility and mortality decline. Kirk (1996: 376) uses the case of Colombia and Mexico with total fertility of 2.7 and 3.2 respectively in 1992, to illustrate the impact of government intervention. The Colombian government supported family planning since the 1960s compared to the Mexican government, which initially opposed family planning but reversed its stand 1972. Although socio-economic conditions were higher in Mexico in 1992, total fertility was lower in Colombia due to the extent of government involvement. Kirk (1996: 376) also shows how government intervention was unsuccessful in Pakistan. Kirk attributes the success of government intervention with the readiness of people to accept contraception, stated otherwise: the success of diffusion. As mentioned earlier Palloni (2001: 68) notes that new ideas can be accepted or rejected. In South Africa, the case of government intervention is very apparent with the launching of the National Family Planning Programme in 1974 although the South African government had strongly supported family planning since the 1960s (Swartz 2003: 11). The National Family Planning Programme was politically motivated to reduce the growth rate of black/Africans. The programme resulted in an accelerated fertility decline among black/Africans.

The key to the causality of fertility decline lies in the diversity of social, economic, cultural, traditional, linguistic and political circumstances of populations. No single factor can wholly explain the mortality and fertility decline and neither can factors hold the same significance for triggering the demographic transition in different populations.

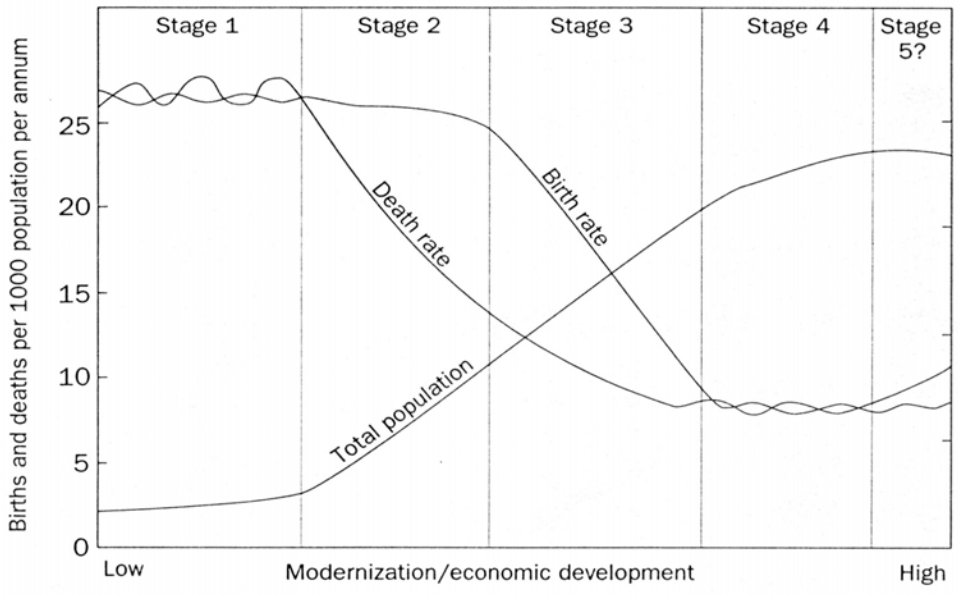
However, despite the wide range of factors responsible for the decline in fertility, modernization is generally accepted as a principal cause of fertility decline through reduced infant and reduced child mortality rates (Beaver 1975: 8, Teitelbaum 1987: 35, Kirk 1996: 379). It is questionable whether fertility rates would decline to replacement levels in the absence of modernization.

2.3 Statement of the demographic transition theory

The earlier formulated three-staged demographic transition model has been extended to a four-stage model. The transitional stage was divided into a mortality transition stage and a fertility transition stage. Furthermore, increasing mortality being observed in post-transitional populations as a result of population ageing is raising the possibility of a fifth stage (Figure 2.1).

Stage 1 is characterised by high and fluctuating mortality and fertility rates resulting in low population growth. High fertility is driven by high rates of infant mortality and child mortality resulting in low population growth.

Figure 2.1: The contemporary demographic transition model



Source: Unknown

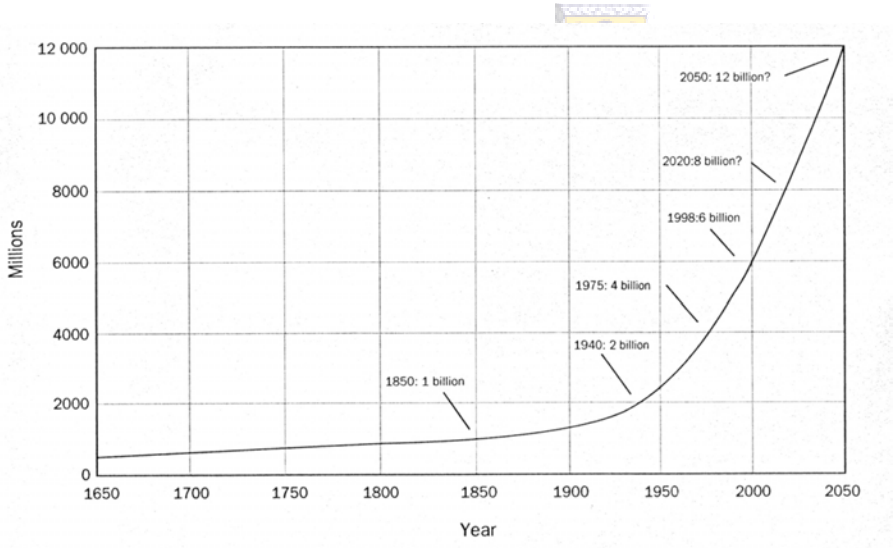
Stage 1 of the demographic transition theory is characteristic for most of human history, estimated between 2 to 5 million years (Ziehl 2002: 24, Hassan 1980: 305). Disease and famine plagued the hunter-gatherer and farming populations of this stage.

In Stage 2 mortality levels decline rapidly whilst fertility levels remain high. Fertility decline

commences afterwards at a relatively slower pace. The rapidly declining mortality coupled with high fertility creates a 'demographic gap' (Ziehl 2002: 25). This gap consequently results in a 'population explosion' and is characterised by rapid population growth. In some instances fertility levels increase in this stage as women are healthier and more children survive to adulthood due to mortality decline (Mackenzie 2000: 117, Ziehl 2002: 27). The period of rapid population growth is shown from 1900 onwards, with the steep incline in total population (Figure 2.2).

Fertility decline accelerates in stage 3 whilst mortality decline decelerates. In stage 4 population growth is stabilised due to low and fluctuating mortality and fertility rates. However as mentioned earlier, mortality levels have been observed to increase in the post transitional stage with the negative population growth likely to induce a fertility rise, thus the possibility of expanding the demographic transition model to include a fifth stage.

Figure 2.2: Historic and projected total world population growth curve



Source: Unknown

World population is however projected to increase exponentially (Figure 2.2) as very populous countries experience transitional growth.

The following key factors can be attributed for the mortality transition (Beaver 1975: 5, Kirk 1996: 368, Mostert *et al* 1998: 13, Ziehl 2002: 26-27):

i. The Industrial Revolution which started in the middle of the eighteenth provided resources and initiated processes that prompted mortality decline:
   - Improvements in the agricultural sector resulted in increased food supplies. Nutrition was improved and resistance to infectious diseases increased. For example the introduction of the potato to Europeans by Spanish colonists from South America.
   - Improvements in sanitation levels like better sewerage systems reduced chances of catching infectious water-borne diseases like typhoid, cholera, diarrhoea and dysentery.

ii. The medical revolution extending from the last third of the nineteenth century to the present reduced mortality rates due to:
   - Improved and effective disease treatment methods for example the discovery and use of antibiotics from Fleming's discovery of penicillin and its synthesis in 1943 and discoveries by Pasteur, Koch and others.
   - Introduction of vaccinations for disease treatment and for immunization purposes particularly for infants and children.

iii. The spread of results and processes of the industrial revolution and the medical revolution to developing countries.

The following key factors can be attributed for the decline in fertility (Beaver 1975: 9, Lesthaeghe 1983: 431, Kirk 1996: 375-369, Ziehl 2002: 27-29):

i. The decline in mortality levels; particularly the drop in infant and child mortality rates ensured the survival of more children consequently there was no need to conceive many children to ensure that some reach maturity. Exceptions have been noted in France and Hungary where birth rates started declining before the onset of mortality decline.

ii. Industrial development replaced agriculture as the only source of income. The shift from an agrarian based to an industrial based way of life reduced the need for large

families.

iii. Changing of cultural values, linguistic ideals and traditional norms. Attitudes of people changed to become more secular, materialistic and individualistic.

iv. Government intervention in the following areas:

- Compulsory education for children and the prohibition of child labour increased the costs of raising children.
- Promotion of family planning and modern contraception methods.
- Advocating for women empowerment through increased education and job opportunities for women. With economic empowerment women gain reproductive independence and there is a move from motherhood being the central role for women.

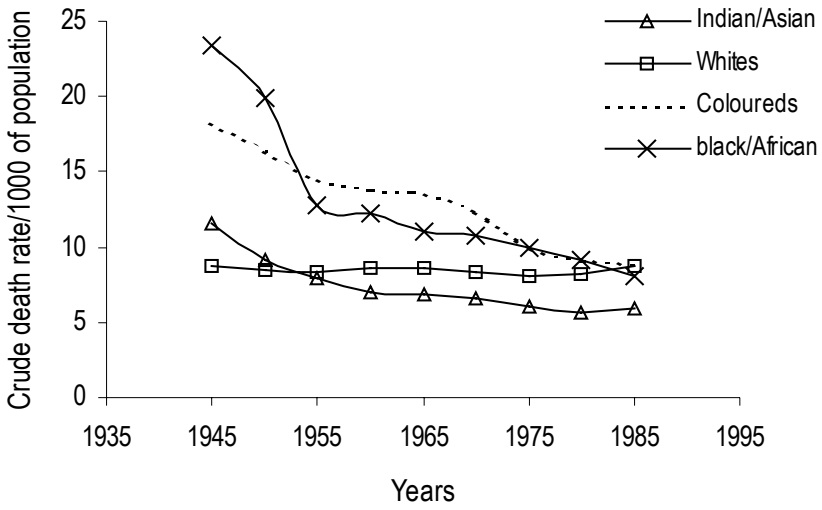
v. The diffusion or spread of contraception ideas and family planning information.

2.4 The demographic transition in South African

Mortality and fertility rates have been declining in South Africa with rates documented from 1945 (Mostert *et al* 1998: 76,124). However the pace of decline had been varied across the four general population groups (Figures 2.3 and 2.4). Levels of mortality for the black/Africans in 1945 were still relatively high with rates of 23.4 per 1000 of the population compared with rates of 18.3 for the Coloureds, 11.6 for the Indian/Asians and 8.8 for the White population. The rapid decline in mortality of the black/African population from 1945 to 1955 illustrates their mortality transition.

The less rapid mortality decline of the Indian/Asians and Coloureds from 1945 coupled with the lower crude death rates compared to the black/Africans illustrates that these populations were in later stages of their demographic transition. The White population had already completed its mortality transition, as indicated by the low and almost steady death rates. The slight increment in crude death rates of the White population and the Indian/Asians from 1980 to 1985 can be attributed to population ageing.

Figure 2.3: Crude death rates across population groups in South Africa: 1945 to 1985

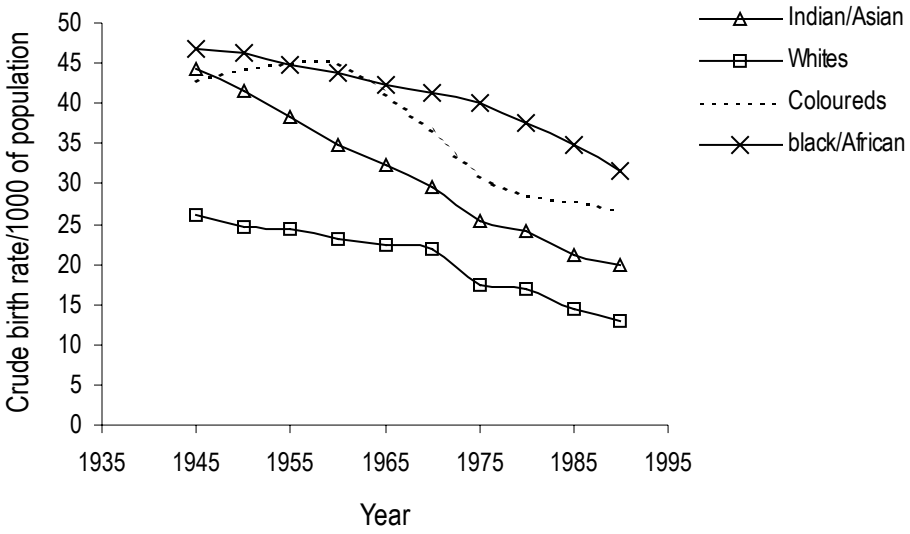


Source: Mostert et al (1998: 76)

Fertility decline across the population groups in South Africa is evident from Figure 2.4. Although relatively high crude fertility rates of 46.8, 44.2 and 42.9 live births per 1000 of the population were present in the black/African, Indian/Asian and Coloured populations in 1945 respectively, by 1985 fertility rates of the Indian/Asians were 21.2, the Coloureds 27.9, whilst the black/Africans had a rate of 34.9 live births per 1000 of the population. The relatively lower crude birth rates of the white population declined from 26.1 in 1945 to 14.4 per 1000 of the population in 1985.

Therefore the demographic transition has been taking place within the South African population proving its validity. The demographic transition of the black/African population will be discussed in detail in the following section.

Figure 2.4: Crude birth rates across population groups in South Africa: 1945 to 1990



Source: Mostert et al (1998:124)

2.5 The demographic transition of black/Africans

To understand the demographic transition of the black/Africans and the context in which it occurred, a brief discussion of South African history will be provided. The discussion will be limited to events considered to have significantly affected the demographic history of black/Africans.

i. Colonialism: The first European settlers and their slaves arrived in South Africa, in the Cape in 1652 (Mostert *et al* 1998: 25). These European settlers would later interfere with the way of life of the black/Africans.

ii. Zulu wars: *Mfecane* is a Nguni word that is used to refer to the wars and disturbances that took place in the rise of the Zulu kingdom during the 1820s. The rise of the Zulu kingdom under Shaka resulted in warfare with many chiefdoms. The resultant deaths, famine and disease reduced the black/African population in South Africa (Mostert *et al* 1998: 26).

iii. Boer Trek: 15,000 Whites (Afrikaner Boers) emigrated from the Cape to the northern parts of the country from 1835 (Mostert *et al* 1998: 26). This great trek started the displacement of the black/Africans from their land and resulted in warfare with the Xhosa and the Zulu nations who were defeated because of the

relatively superior weaponry of the Boers.

iv. Migrant labour: Diamond and gold mining fields were discovered in South Africa in the 1860s and mid-1880s respectively. Black/Africans from across the country were employed as mine workers but had to reside in single sex compounds or hostels close to the mines. Therefore a migrant labour system was established.

v. Segregation and apartheid policies: The Land Act of 1913 divided land into 'white' land and African Reserves. 'White' land constituted 87% of the land whilst African Reserves were initially 7% but were increased to 13% of the land in 1926 (Ross 1999: 88). Furthermore the Group Areas Act of 1950 cleared centers of black populated areas, termed 'black spots'. The result of both laws was the forced migration of Black/Africans population from the 'white' areas to the African reserves (also referred to as Bantustans).

vi. The industrialization of South African cities after the second world war, in particular Johannesburg.

Pre-transitional mortality and fertility rates

Mortality and fertility rates of the black/Africans at the beginning of the twentieth century are estimated to have been approximately 45 per 1000 for the fertility rate with mortality rates of 35 to 40 per 1000 of the population (Mostert *et al* 1998: 27). Pre-transitional mortality was at such high levels due to several possibilities:

i. The lack of advanced medical technology for disease treatment and for controlling pandemics increased mortality. An estimated 500 000 non-Whites died during the influenza pandemic of 1919 (Mostert *et al* 1998: 28). Mackenzie (2000: 115) refutes the explanation of high death rates resulting from the prevalence of tropical diseases like malaria, as they have not caused many deaths in South Africa.

ii. The *Mfecane* and wars with the Boers increased death rates of the black/Africans however Mackenzie (2000: 116) questions the extent to which these wars contributed significantly to the high crude rates of mortality.

iii. Famines, droughts and bad harvests resulting in hunger spells. Ross (1999: 145) explains (although to a less extent), that "…the annually recurring hungry months

before the harvest which had controlled the country's population in pre-colonial times…". Furthermore, Ross (1999: 144) makes reference to the "…Rinderpest epizootic of the 1890s."

Pre-transitional fertility levels were high probably due to the following:

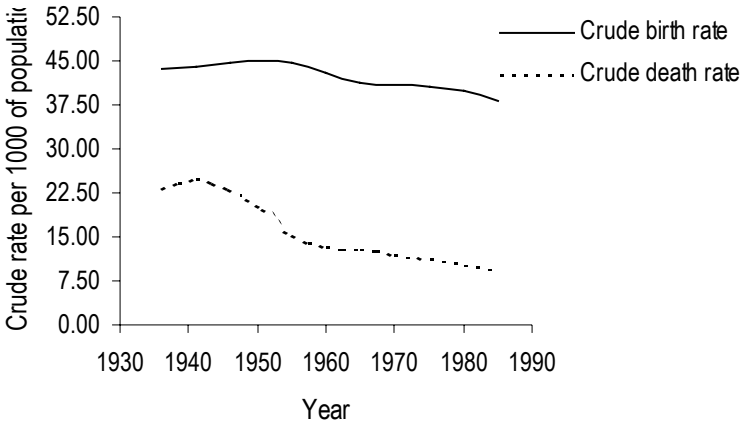
i. The high death rates in particular the high infant mortality during the pre-transitional period led to more babies being born to ensure that some survive to adult.
ii. The mainly agricultural based way of life of the black/Africans in which children were seen as manpower.

Mackenzie (2000: 114) challenges the notion of uncontrolled fertility in pre-transitional societies and asserts that South African women (and the rest of Africa) used traditional methods of family control like; sex between the thighs, breastfeeding, terminal abstinence and returning home after having a child.

Transitional mortality and fertility rates

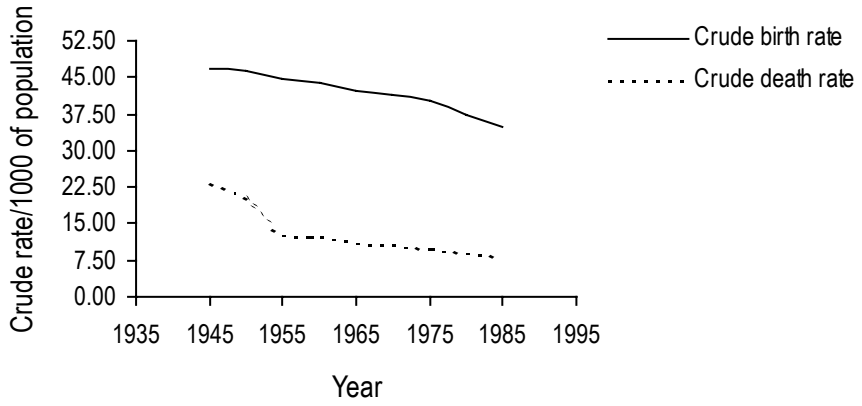
Historic rates of the black/Africans estimated from 1936 to 1985 and from 1945 to 1985 respectively are provided in Figures 2.5 and 2.6 below.

Figure 2.5: Mortality and fertility rates of the black/African population: 1936 to 1985



Source: Sadie (1988: 50)

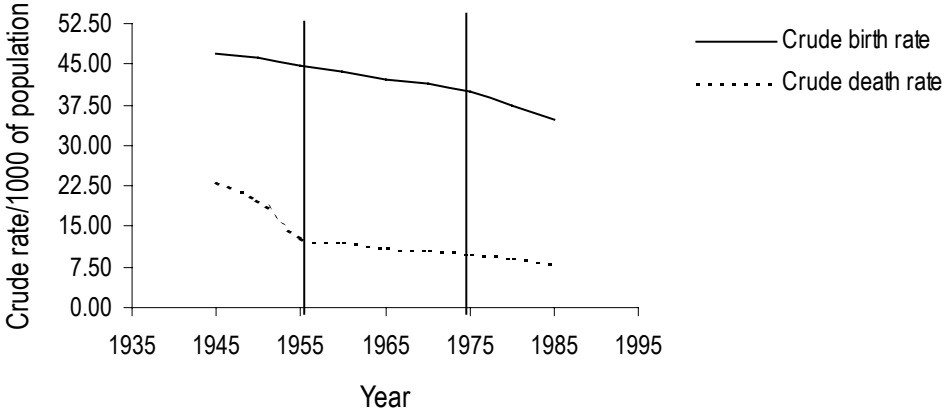
Figure 2.6: Mortality and fertility rates of the black/African population: 1945 to 1985



Source: Mostert et al (1998: 76,124)

The declining mortality and fertility rates are evident from Figures 2.5 and 2.6. When periods of mortality and fertility decline in figure 2.6 are divided into stages, the pattern of demographic change denoted by the demographic transition theory can be clearly seen (Figure 2.7).

Figure 2.7: Stages of mortality and fertility decline of the black/African population: 1945 to 1985



Source: Mostert et al. (1998: 76,124)

Stage 1 of figure 2.7 is characterised by a steep mortality decline. Crude rates of mortality declined from 23.4 in 1945 to 12.8 per 1000 of the population in 1955. Stage 1 of figure 2.7 corresponds to stage two of the demographic transition model. In stage 2 of figure 2.7, mortality decline recedes whilst fertility is still declining at a slow pace. The reduced pace of mortality decline coupled with slowly declining fertility constitutes the end of stage two of the demographic transition model. Fertility decline accelerates in stage 3 of figure 2.7 with rates of 40 per 1000 of the population in 1975 declining to 34.9 in 1985. This accelerated decline in fertility is consistent with stage three of the demographic transition model. The black/African population has thus been undergoing mortality and fertility decline estimated from the early twentieth century. These declines are consistent with the pattern of demographic change proposed by the demographic transition theory.

The role of modernization in triggering the mortality and fertility decline of the black/African is however, not clear. Mortality declined during a period of forced removals of black/Africans into the African Reserves or Bantustans. This relocation caused decreased land availability, decreased cattle availability and poor wages. Therefore, instead of improved socio-economic conditions (increased modernization) during the mortality and fertility decline, the reverse (reduced socio-economic position) was occurring (Mackenzie 2000: 112-113, Swartz 2002: 11). However in spite of the adverse effects of the forced removals, other processes of modernization occurring at the same time contributed to the decline in mortality and fertility rates.

The mortality decline of the black/Africans can be attributed to the following factors:

i. Employment in the mining industry provided income to supplement and increase the agricultural economy. Therefore nutrition and standards of living increased thus reducing mortality as Ross argues:

> Migrant earnings were ploughed back into the agricultural economy of the Reserves, to the extent, for instance, that by 1930 there were nearly two and a half times as many cattle in the Transkei as a dozen years earlier, and three times as many sheep. In addition, the territory's maize yield reached its peak in 1925 (1999: 93).

ii. The industrialization of post world war two South Africa through diversifying the economy and rapidly expanding manufacturing and construction sectors of the economy created employment for black/Africans and access to goods and services thus reducing sole reliance on subsistence produce.
iii. Improved access to medical services by black/Africans.

However overcrowding coupled with the fact that land in the reserves was the least arable and least water resourced resulted in the degradation of the reserves. Ross argues:

> Slowly, too, the agricultural side of the reserve economy began to crumble. What were said to be rural, agricultural districts became ever more dependent on the import of food…the steady collapse of the Reserves' agricultural economies turned many once lush areas, for instance in the Ciskei, in Zululand…into treeless near-deserts (1999: 145,147).

The bad state of the reserves started the migration of men and women in particular to migrate and settle in the cities of South Africa (Ross 1999: 149). Migrant labour had already been established through mining employment opportunities.

The fertility decline of the black/Africans can be explained from the following:

i. The reduction in the infant mortality rate meant that survival of children increased therefore reducing the need for numerous births to ensure survival of some to adulthood. Mostert *et al* (1998: 77) estimate that infant mortality declined from 182.5 per 1000 of the population between 1945 and 1950, to 60.6 per 1000 in 1985. The steepest decline of 47% occurred in the period 1945 to 1960 from 182.5 to 97.6 per 1000 of the population.
ii. The increased rate of urbanization among the black/African women contributed to the decline, as urbanization is associated with rising levels of social and economic development, increased contraception use and increased education levels. However apartheid policies deterred black/African mass urbanization through the passing of for instance, the Urban Labour Preference Policy and the Abolition of Passes and Documents Act of 1952 (Ross 1999: 119). According to Mostert *et al* (1998: 137), the urban black/African population increased from 10% in 1904 to 32% in 1960 and 35% in 1991.

iii. The migration of males affected fertility patterns by disrupting marriage patters and causing marital instability (Mostert *et al* 1998: 140, Swartz 2003: 15).

iv. The implementation of the National Family Planning Programme in 1974 by the South African government provided contraception free of charge to black/Africans. However to explain the 'spread' and the 'adoption of the ideas' of contraception, which the apartheid government was availing to the black/Africans, diffusion theories have to be explored. Mostert *et al* (1998: 140) attribute radio, television, printed media and the transport infrastructure as agents of diffusion. Swartz (2003: 12-13) on the other hand, attributes the fact that as the only breadwinners (due to the migrant labour system), women were forced to use contraception. However, fertility could have declined because there was an 'unmet' need for modern and more effective contraceptive methods among the black/African population and when the 'unmet' need was 'met' (through the National Family Planning Programme), fertility declined. Contraception use among black/Africans increased to levels 50.4% in 1990.

According to the demographic transition theory, the observed mortality and fertility decline of the black/African population would continue, until population stability is attained with low mortality and low fertility rates. However, HIV/AIDS is sweeping through the black/African population, increasing death rates and expected to lower the already declining fertility rates. This research explores the distortion that HIV/AIDS is projected to have on the demographic transition of the black/Africans. The research does not disregard the classic demographic transition theory put forward by Landry (1909, 1934), Thompson (1929) and Notestein (1945) and subsequent refinements of the theory, the purpose of this study is to investigate the impact of HIV/AIDS.

In this chapter, the demographic transition theory was reviewed. Criticisms of the transition theory were highlighted particularly regarding how the theory is applicable to developing countries and reasons for the fertility decline. A discussion of the historic demographic transition of the black/African population was provided, however the relatively higher prevalence of HIV/AIDS within the black/African population is expected to alter the expected future course of the transition. Methodological assumptions in projecting the impact of HIV/AIDS on the demographic transition will be discussed in chapter three.

Chapter three

Methodological assumptions

3.1 Introduction

This section discusses assumptions made in determining the impact of HIV/AIDS on the demographic transition of the black/African population. The ASSA2002 model of the Actuarial Society of South Africa (ASSA) was selected to project the impact of HIV/AIDS on mortality and fertility rates. The model was also used as a basis for projections of the impact of HIV/AIDS on modernization. The structure of the ASSA2002 model is discussed first along with some key HIV assumptions of the model. Assumptions on the impact of HIV/AIDS on modernization are discussed in the second section.

3.2 The ASSA 2002 model

3.2.1 The structure of the ASSA2002 model

The ASSA2002 model (full version) divides the South African population into the four general population groups: black/African, Indian/Asian, Coloured and White. Each population is split by sex and by age into a young population aged 0 to 13 years, an adult population aged 14 to 59 years of age and an old population 60 years and older.

The adult population (aged 14-59) is divided into four risk groups according to their risk of contracting HIV through heterosexual activity. Dorrington, Johnson and Budlender (2004: 6) define each risk group as follows:

PRO: "Individuals whose level of sexual activity is such that it is similar to that of commercial sex workers and the level of condom usage and infection with STDs is similar to that of the STD group."

STD: "Individuals whose level of sexual activity is such that their HIV prevalence is similar to someone regularly infected with STDs."

RSK: "Individuals with a lower level of sexual activity, but who are still at risk from HIV in that they have, on average, one new partner per annum and sometimes engage in unprotected sex."

NOT: "Individuals who are not at risk of HIV infection".

Individuals in the RSK group do not by definition engage in sex with a PRO group individual. Furthermore, the NOT group individuals only have sex with persons also in the NOT group or if they engage in sex with persons from the other groups then they always take "effective precautions" (Dorrington, Johnson and Budlender 2004: 6). However the restriction of sexual activity to certain groups of people is questionable in depicting reality.

Individuals in the young population group (aged 0 to 13) are allocated to the NOT adult group on their 14th birthday and thereafter allocated to the other three adult groups (PRO, STD and RSK) according to their level of sexual experience until the age of 25. Individuals aged 25 and older are allocated to the four risk groups according to proportions stated in table 3.1. It must be borne in mind that the accuracy of modeling sexual behavior may be limited as behavior can easily change and fall outside the probable range provided by population projections.

Table 3.1: Proportions of risk group allocations of black/Africans.

RISK GROUP	PERCENTAGE OF MALE POPULATION	PERCENTAGE OF FEMALE POPULATION
PRO	1.2%	1.2%
STD	25.0%	25.0%
RSK	25.0%	25.0%
NOT	48.8%	48.8%
TOTAL	100.0%	100.0%

Source: ASSA2002

In the ASSA2002 model, 48.8% of black/Africans are assumed to not be at risk of HIV infection and are allocated to the NOT group (Table 3.1). The proportion of the NOT group determines to a large extent the level at which the HIV/AIDS pandemic plateaus

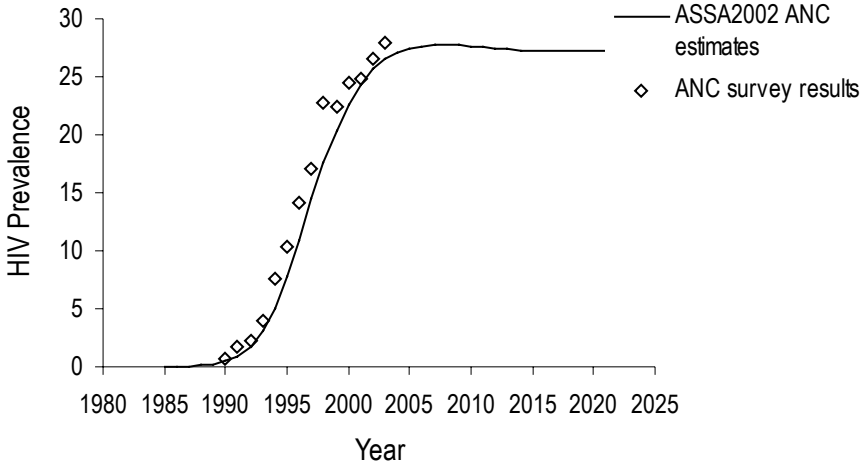
through the antenatal prevalence (Dorrington, Johnson and Budlender 2004: 25). An analysis was conducted varying the proportion of the NOT group to determine the impact on HIV prevalence (Refer to Appendix I). For purposes of this research, the NOT group was considered to be 48.8% since assumptions stated in the ASSA2002 model by the AIDS Committee will be taken as the most likely assumptions.

The adult population (aged 14 to 59) is allocated to the OLD group on their 60th birthday. Individuals are still subdivided by the duration since HIV infection except that ASSA2002 assumes no further HIV infections after the age of 60 years. An assumption of no fertility beyond the age of 60 is also made for females in the OLD group. No individual is assumed to live beyond the age of 90 in the ASSA2002 model.

3.2.2 HIV calibration and modelling

The ASSA2002 model is calibrated to reproduce results of the antenatal survey (Figure 3.1). The ASSA2002 model uses the 2002 antenatal clinic (ANC) results as the latest calibration data.

Figure 3.1: HIV prevalence among antenatal attendees according to the ASSA2002 model and according to the Department of Health annual survey.



Source: ASSA2002 model and Department of Health (2004: 6)

The ASSA2002 estimated antenatal prevalence can be observed to be a good fit of the observed antenatal clinic prevalence levels from the close fit of the survey points along the estimated curve. Limitations of the ANC data were highlighted in chapter one.

3.3 Impact of HIV/AIDS on modernization

3.3.1 Modernization as human development

Modernization has been discussed as one of the principal causes of the demographic transition in chapter two. Although other forces have also triggered the fertility decline, however modernisation is considered as the main determinant of the fertility decline by reducing infant mortality rates (Beaver 1975: 8, Teitelbaum 1987: 35, Kirk 1996: 379). Therefore to investigate the impact of HIV/AIDS on the demographic transition, mortality rates, fertility rates and modernization will be included in the analysis. Modernization was selected as one of the key factors behind the demographic transition, either to initiate the decline or to maintain and sustain the decline to post transitional levels. HIV/AIDS is expected to affect all elements of the transition hence the impact of the pandemic needs to be explored simultaneously on mortality rates, fertility rates and causality (taken as modernization). Therefore in this research, the impact of HIV/AIDS on modernization will be explored alongside the impact of the pandemic on mortality and fertility rates.

Modernization was discussed as being synonymous with processes of industrialization, urbanization, education, social development, and economic development, all of which result in increased life expectancy, improved standards of living, increased literacy, and empowerment of women. Thus, to investigate the impact of HIV/AIDS on modernization, a suitable measure of modernization with the ability to combine several aspects linked with modernization into a single quantifiable measure was essential. The concept of human development was identified as a close measure of modernization.

Human development is defined as, "…a process of enlarging people's choices. The most critical ones are to lead a long and healthy life, to be educated and to enjoy a decent standard of living" (UNDP 1990:2). The definition of human development encompasses three end-

results of modernization namely: life expectancy, standard of living and education. The concept of human development is used to assess human progress, one of the results of the demographic transition as populations become more modern. Human development is measured by the human development Index (HDI).

3.3.2 Human development index

The human development index (HDI) of the United Nations Development Programme (UNDP) reflects the "…ability of individuals within a country or across various countries to live long, informed and comfortable lives" (Statistics South Africa 2001: 1). The HDI is computed from three measures: longevity, educational attainment and income:

i. Longevity: measured by life expectancy at birth
ii. Educational attainment: measured by adult literacy and combined gross primary, secondary and tertiary enrolment ratio. The educational attainment index is then computed by weighting the two variables, two-thirds to adult literacy and one-third to the combined gross primary, secondary and tertiary enrolment ratio
iii. Income: measured by gross domestic product (GDP) per capita, converted to purchasing power parity in dollars (PPP$), to allow international comparability (Statistics South Africa 2001: 1):

The HDI is measured on a scale of 0 to 1 with an HDI of 0 reflecting the lowest human development and a value of 1 indicating the highest human development. High human development corresponds to an HDI value between 0.8 and 1; medium human development is between 0.5 and 0.799 and human development indices below 0.5 reflect low human development.

The HDI however, is a generalised population index not reflecting individuality, and how individuals deviate from the general norm (Statistics South Africa 2001: 8). Criticisms have also been raised regarding the quality of data used in computing the HDI and concerning the changing of methodology, which makes year-to-year and country comparisons difficult (Morse 2003: 285, Neumayer 2001: 103). Furthermore, the HDI does not include political or religious factors directly in its formulation. Nevertheless despite not being an exhaustive

measure of human development, the HDI is widely used as it allows comparability across different populations and over time. Projections of the HDI in this study were conducted in light of the limitations of the index as Morse (2003: 296) cautions, "Simple and highly aggregated indices are supposed to help…but may also mislead and need to be handled with care."

Therefore to determine the impact of HIV/AIDS on modernization, estimates of HDI components were projected to the year 2021. Population projections of the ASSA2002 model were used as a basis (where appropriate) in producing projections of the human development index to allow for a coherent and linked analysis of the demographic transition. Although computational methods of the HDI have been revised since its inception in 1990, the latest recommended formulas (Refer to Appendix II) have been used to compute historical and projected HDI values (Morse 2003: 286). The assumptions made in projecting the impact of HIV/AIDS on the human development index will be discussed in the following section.

3.3.2.1 Impact of HIV/AIDS on longevity

Longevity is measured using the life expectancy at birth indicator. Life expectancy at birth is the average number of years a newborn baby is expected to live at birth if the mortality patterns at the time of birth remain constant throughout the infant's life. HIV/AIDS is increasing mortality rates thus reducing expectations of life at birth. Life expectancies were obtained from runs of the ASSA2002 model.

3.3.2.2 Impact of HIV/AIDS on education attainment

Education attainment is computed from two educational variables; combined gross primary, secondary and tertiary enrollment and adult literacy. Components of the educational attainment index can be defined as follows:

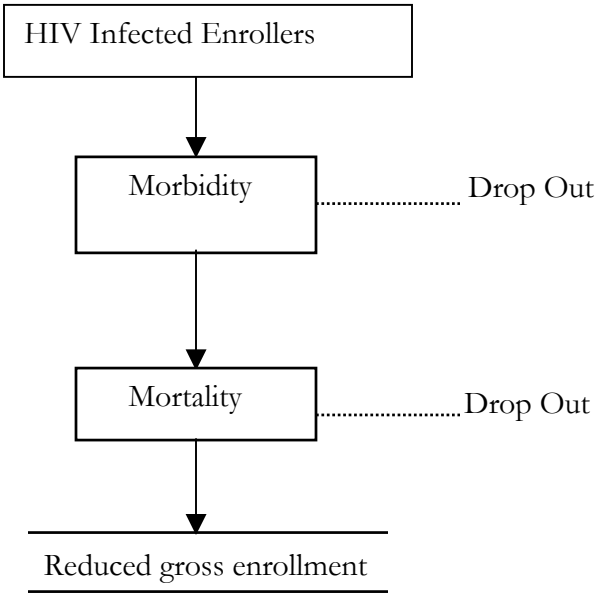
i. Adult literacy: "The percentage of people aged 15 and above who can, with understanding, both read and write a short, simple statement on their everyday life (Statistics South Africa 2001: 24) ". The adult literacy rate is calculated as the number of persons with grade 7 and higher as a percentage of all persons 15 years and older.
ii. Combined gross primary, secondary and tertiary enrollment: "The combined gross primary, secondary and tertiary enrollment ratio refers to the number of students at all these levels as a percentage of the population of official school age for these levels" (Statistics South Africa 2001: 24).

The educational attainment index is then obtained by assigning a weight of two-thirds to adult literacy and one-third to the combined gross primary, secondary and tertiary enrollment ratio.

The impact of HIV/AIDS on education is threefold: demographic, socio-economic and psychological. Demographic; by reducing the population of young people, socio-economic; through impacting household financial and social arrangements and psychological through its emotional damage on young people (Economic Commission for Africa 2000: xi). Education attainment is being threatened by HIV/AIDS as noted by the World Bank, "Achieving Education for All in a world of AIDS presents an unprecedented challenge to the world's education community" (2002: ix).

Three groups of school children potentially at greatest risk from HIV/AIDS were identified by Bennell *et al* (2002: 48) as: HIV positive children, children in households with AIDS sick family members and children whose parents or guardians have died of AIDS. Incorporating the three groups of school children, the impact of the pandemic on primary, secondary and tertiary enrolment is therefore either directly through HIV infected enrollers or indirectly from HIV/AIDS affected enrollers (Figures 3.2 and 3.3).

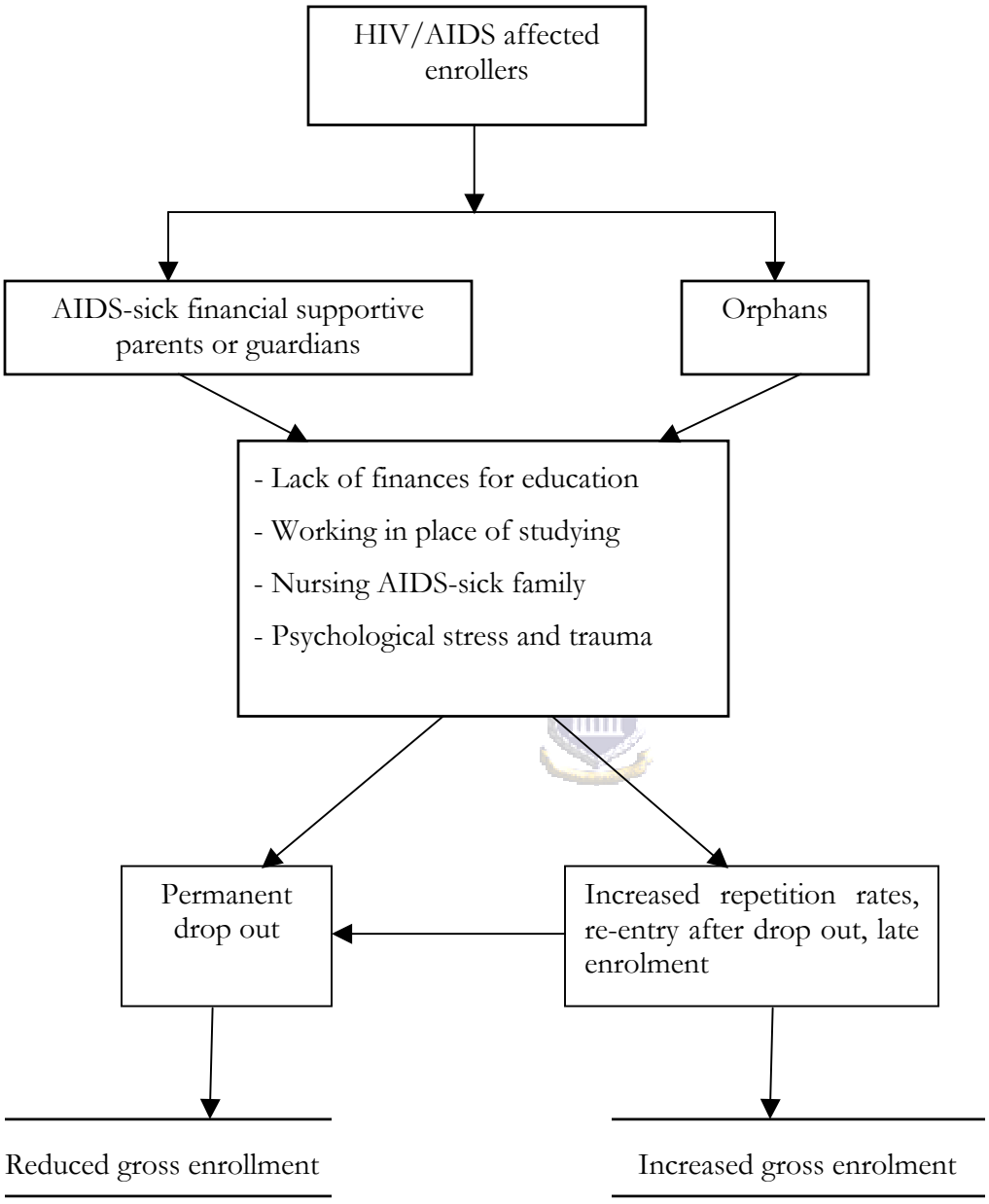
Figure 3.2: A schematic flow of the impact of HIV infection of students in primary, secondary and tertiary institutions.



HIV infected enrollers result in reduced gross enrolment either from dropping out during stages of AIDS related illnesses or dropping out after death (Figure 3.2). HIV/AIDS affected enrollers are grouped into orphans and enrollers with AIDS-sick financially supportive parents or guardians, with allowance for moving into the orphan category upon death of AIDS sick parents.

An orphan is defined as a child under the age of 15 who has lost either a mother or both parents (ASSA2002). HIV/AIDS affected enrollers are expected to either increase gross enrolment through re-entry into school after drop out, grade repetition or late enrolment, or reduce gross enrolment by permanently dropping out (Figure 3.3). According to ASSA2002 highest proportion of orphaned children is projected in 2016 where 13.63% of black/African children under the age of 15 will be orphaned. Household financial and psychological strain are the main consequences of the impact of HIV/AIDS.

Figure 3.3: A schematic flow of the impact of HIV/AIDS affected enrollers in primary, secondary and tertiary institutions



Source: Carr-Hill, Kataboro and Katahoire (2000: 6)

The projected impact of HIV/AIDS on measures of educational attainment will be discussed in the following section based on the flow diagrams of HIV/AIDS infected and affected enrollers (Figures 3.2 and 3.3).

Impact of HIV/AIDS on combined gross primary, secondary and tertiary enrolment

Literature on HIV/AIDS and education anticipates reduced enrollment from the impact of HIV/AIDS in the following ways (Carr-Hill, Kataboro and Katahoire 2000: 10-11, Economic Commission for Africa 2000: xi):

i. Declining fertility rates resulting in a reduced school-going population either through deaths of women in their reproductive years due to AIDS or biological mechanisms of HIV to reduce fecundity (the biological ability to conceive)
ii. AIDS deaths of primary, secondary and tertiary students resulting in a reduced number of enrollers
iii. Increasing drop out rates amongst students.

However according to Hunter and May (2002), a KwaZulu-Natal study shows that the poor place priority on the education of their children, as a means to escape poverty, "…poor households attempt to defend the education of their children in the face of a range of shocks" (Hunter and May 2002: 10). Of the 49% of households that experienced and responded to one or more shocks, only 3% removed children from school indicating a strong defence for children's education (Hunter and May 2002: 20).

Bennell *et al* (2002) argue that "…the alleged correlation between dropping out and orphan hood is more apparent than real" (2002: 60). Bennell *et al* (2002) observed that 18 out of 111 (16.2%) orphans that were interviewed were out of school, although the authors indicated that their sample was biased nevertheless, "…it suggests that drop out rates among orphans are probably not appreciably higher" (Bennell *et al* 2002: 60).

The implications of studies by Hunter and May (2002) and Bennell *et al* (2002) indicate a lesser impact of HIV/AIDS than theoretical considerations expect. However, as Hunter and May (2002) pointed out, households' reaction to shocks depend on the asset base of the family. The asset base (socio-economic conditions) of the black/African population was expected to increase significantly as opportunities and resources previously denied became accessible following the democratic changes in 1994. Instead, the relatively high prevalence

of HIV is set to erode and impede significant asset gain, as family assets are channelled towards medical costs and funeral expenses. AIDS morbidity and mortality of household 'breadwinners' paralyses income generation thus making it harder to defend against school disruption shocks. Collins and Rau note that:

> Poor people are really impoverished people. They are impoverished by inequitable socio-economic structures-on the household level, on the village level, on the national level…. This becomes clear as we look at AIDS as one in a series of "shocks" experienced by the majorities of people in developing countries (2000: 8).

Furthermore, Bennell *et al* (2002) attribute the high enrolment ratios observed in high HIV prevalence countries as a result of the strong schooling culture that keeps most children in primary school. The question then is whether the black/African South Africans have a strong schooling culture enough to avert or lessen the negative impact of HIV/AIDS expected on the education sector?

South Africa achieved independence in 1994 from the apartheid government. During the apartheid era, the 'Bantu' education system introduced for the black/Africans limited their educational training and skills as the policy was designed to be limited and appropriate for the needs of the white run economy (Maharaj *et al* 2000: 9, Ross 1999: 121). Furthermore the inequitable education resource allocation in 'Bantu' schools limited the quality of training.

The enrolment history of black/Africans was affected by the political situation in South Africa. Maharaj *et al* (2000: 9) argues, "Education thereafter [after the introduction of 'Bantu' education] became a focal point of violence and disruption in the struggle to end apartheid. The 1976 Soweto uprising is one of the most infamous…" Nkomo 1990 cited in Maharaj *et al* (2000: 9) stated, "The slogan 'liberation now, education later' became common cries for students and youth participation in protests". Therefore based on the political unrest and inequalities in South Africa and the participation of enrollers in the struggle for freedom, it may be satisfactorily implied that the schooling culture of the black/Africans may not be strong enough to avert the impact of HIV/AIDS.

An analysis of historic gross enrolment rates across primary, secondary and tertiary levels can also be used to ascertain the existence or non-thereof of a strong schooling culture among

black/Africans. Gross enrolment is measured by the gross enrolment rate (GER) defined as "The number of students enrolled in a level of education, regardless of age, as a percentage of the population of official school age for that level" (Statistics South Africa 2001: 24). A GER of more than 100% indicates more learners than the official school age, indicating the presence of under-aged and/or over-aged learners. Inversely a GER of less than 100% indicates fewer learners than the official school age, implying dropping out among official age learners. The official school age for primary enrolment is between the ages of 7 to 13, secondary enrolment official ages are in the range 14 to 18 years old and the official tertiary enrolment population is aged 19 to 24 years.

Table 3.2: Percentage primary, secondary and tertiary historic gross enrolment rates: 1985 to 2000.

YEAR	PRIMARY GROSS ENROLMENT RATES	SECONDARY GROSS ENROLMENT RATES	TERTIARY GROSS ENROLMENT RATES
1985	110.64	46.19	2.47
1986	110.55	48.39	3.00
1987	112.76	53.61	3.62
1988	113.31	58.54	4.26
1989	112.39	62.19	4.89
1990	112.68	66.53	5.46
1991	114.57	71.27	6.25
1992	116.17	76.10	6.45
1993	121.37	79.82	7.28
1994	124.90	82.69	7.82
1995	129.05	87.00	10.14
1996	120.00	90.00	11.46
1997	112.00	90.00	12.88
1998	108.00	90.00	14.30
1999	106.18	89.45	14.03
2000	100.00	87.00	15.73

Source: Research institute for Education Planning (RIEP) cited in the 1995 South African Statistics for values from 1985 to 1994, the author estimated values from 1995 to 2000 from various sources.

Gross enrolment rates (GERs) for primary enrolment were fluctuating in the period 1985 to 1990. Primary GERs increased from 112.68% in 1990 to a high of 129.05% in 1995, indicating repetition, re-entry and late entry into primary school following achievement of democracy. Primary GERs subsequently declined from 1996 onwards reaching 100% in 2000. The attainment of a GER of 100% was obtained as official ages were implemented and the inequalities of the past education system were addressed as rates of repetition, re-entry and late entry into primary school declined.

Gross enrolment ratios (GERs) for black/African secondary enrollers estimated at 46.19% in 1985, increased to 90% in 1996. However the GER stagnated at 90% from 1996 to 1998 and thereafter started declining to a rate estimated at 87% in 2000. Similarly primary GERs started increasing from levels estimated at 100% in 2001 to 116% in 2001. These observed reversals in the trends of GERs of both primary and secondary enrolment might indicate the impact of HIV/AIDS, hence substantiating the claim that the schooling culture among black/Africans may not be strong enough to mitigate the impact of HIV/AIDS.

A positive trend in tertiary GERs was estimated from 1985 to 2000 with rates calculated at 16% in 2000. Tertiary enrolment exhibited low GERs of below 10% until 1995, showing the impact of the political instability of that period. Contrary to primary and secondary GERs, there are no apparent trend indications of the impact of HIV/AIDS on the tertiary gross enrolment rates.

Gross enrolment rates were used as a basis in projecting gross enrolment across primary, secondary and tertiary levels. Historic GERs were computed from observed enrolment totals of black/Africans divided by the ASSA2002 estimated official population. However, gross enrolment rates for primary and secondary enrolment from 1996 and 1995 respectively, were estimated from national GERs due to the unavailability of enrolment totals by population group. This estimation was based on the premise that, "In the years following the democratic elections in 1994…This expansion in enrolment was mainly to the result of African learners' entering the system in large numbers" (Department of Education 2002a: 22). Tertiary enrolment totals were available in the *Statistics Yearbooks* (1999, 2000), in *Education at a Glance* (2001) and in *South African Survey (*1996/1997, 1997/1998, 1999/2000) publications. Unavailable tertiary enrolment totals were interpolated using simple interpolation.

The impact of non-South African population totals was assumed to not have a significant influence on the GERs. For instance in 2000, there were 6.33% foreign students (as a percentage of estimated black/African total enrolments) enrolled at universities and 1.37% foreign students (as a percentage of estimated black/African total enrolments) enrolled at

technikons across South Africa (Department of Education 2002b: 24-37). The foreign students were not reported according to population group, thus the percentages were computed from totals including non-black/Africans. The impact of HIV/AIDS on primary, secondary and tertiary gross enrolment will be discussed separately in the following section and the methodological assumptions stated.

Primary gross enrolment

The impact of HIV/AIDS on primary enrolment is expected to be two fold (Figures 3.3 and 3.4). The following factors are expected to increase gross enrolment:

i. The South African Schools Act of 1996 states compulsory schooling for learners aged 7 to 15. This age group includes mostly primary school learners with official ages between 7 and 13. This law will most likely curb the significant drop out of primary school enrollers
ii. Historic (from 1985) GERs for primary learners have always been greater then 100% indicating the stronger emphasis for primary enrolment
iii. Child labour regulations reduce employment chances for primary school enrollers and thus are expected to encourage primary enrolment.

On the other hand the following factors are expected to simultaneously reduce gross enrolment:

i. AIDS deaths of the primary school enrollers. The ASSA2002 model projects that in the year 2021 the official primary school age population (aged 7 to 13) will be reduced by 18% (1,129,522) compared to a no-AIDS scenario.
ii. Drop out of HIV/AIDS affected enrollers in particular orphans. A study conducted in Zambia showed 32% non-enrollment among orphans in urban areas compared to 25% non-enrolment among non-orphans. In the rural areas, 68% of orphans were not enrolled compared to 48% among non-orphans (Malaney 2000). Malaney (2000) furthermore, estimates an average enrolment of 78% for orphans compared to a national average of 87% in Namibia.

Primary Gross Enrolment Ratios were assumed to increase to a GER of 130% in 2015 from a GER of 116.6% in 2002. The highest number of orphans is projected for 2015 and thus the highest GER of primary school enrolment is expected in that year. The rate of 130 was obtained from a historical review of GERs of the black/African population, a GER of 129 was observed in 1995. Intervention is also allowed for (government and/or non-government) in setting the maximum GER at 130. Linear interpolation was used to project gross enrolment rates from 2002 to 2015. GERs were assumed to decrease to 128 in 2021. Primary school dropouts were assumed at 25% of annual orphan estimates of the ASSA2002 model. The rate of 25% was based on the study conducted in Zambia that Malaney (2000) cited.

Secondary gross enrolment

HIV/AIDS is expected to reduce secondary enrolment since the official secondary age group (aged 14 to 18) is assumed to easily seek employment and assume responsibility for the younger siblings. According to UNAIDS (2000: 28), a study of commercial farms in Zimbabwe were most farm workers had died of AIDS 'not one orphan of secondary school age was still in school'. Such results indicate the negative impact of HIV/AIDS on secondary enrolment figures. Furthermore the stagnation and decline of GERs exhibited from 1996 to 2000 supports the hypothesis of reduced gross enrolment. The official age secondary population (aged 14 to 18) is projected to reduce by 13% (585, 711) as a result of AIDS deaths by 2021 (ASSA2002).

Secondary GERs were assumed to decline from 86% in 2001 to 70% in 2018 and remain constant until 2021. Secondary gross enrolment is assumed to be affected by levels of AIDS sick individuals which peak in 2016 then decline from 2017 onwards at levels below 0.5%. The slow rate of decline in AIDS sick individuals is the reason for the constant GER rates of secondary enrollers from 2018 to 2021.

Tertiary gross enrolment

Gross tertiary enrolment will be assumed to be affected mainly by AIDS deaths and not significantly affected by the indirect impacts of the pandemic. The ASSA2002 official tertiary population (aged 19 to 24) will reduce by 8% (415,673) by 2021.

Tertiary enrolment from 2002 to 2021 was assumed at a constant percentage of the ASSA2002 official tertiary aged population aged 19 to 24 years. The constant percentage was taken as 16.02%, which is the percentage tertiary enrolment in 2001. When the ratio of projected secondary enrolment to projected tertiary enrolment was computed, the ratio was fluctuating but declining indicating increased continuance of secondary enrollers to higher education, in line with the observed declining historical ratio.

Impact of HIV/AIDS on the adult literacy rate

Adult literacy is computed from the number of persons with grade 7 and higher as a percentage of the population aged 15 years and older. AIDS mortality is being felt in both the numerator (persons with grade 7 and higher) and the denominator (population 15 years and older) of the adult literacy rate simultaneously.

However adult literacy rates have been increasing since 1985 with figures for each census year (Table 3.3). The rate of growth from one census to the next has declined, with only a 14.20% increase from 1996 to 2001, compared to a 28.86% increase for the period 1991 to 1996. The adult literacy rates were computed using the ASSA2002 population aged 15 years and older estimated at 1 July of each year.

Table 3.3: Functional adult literacy rates for black/Africans for 1985, 1991, 1996 and 2001

YEAR	TOTAL GRADE 7 AND HIGHER	ASSA2002 POPULATION AGED 15 YEARS AND OLDER	ADULT LITERACY RATE
1985	4108489	14069126	29.20
1991	7594369	16487017	46.06
1996	12074836	20342502	59.36
2001	15410410	22734530	67.78

The adult literacy rates for the black/African population are expected to increase from 2001 to 2021 based on the following:

i. Compliance with the South African Schools Act of 1996, which states compulsory schooling for learners, aged 7 to 15. The compulsory schooling age group coincides with the official ages for primary school learners (7 to 13 years) the numerator in the adult literacy rate fraction.
ii. Increased gross enrolment rates of primary school learners expected during study period, indicate learners re-enrolling, late enrolment or repetition as opposed to permanent drop out. This is expected to reduce the declining effect of HIV/AIDS on the number of persons with Grade 7 and higher.
iii. The increased adult literacy rate from 1996 to 2001 during a time when other indicators of education attainment (primary and secondary gross enrolment) were responding negatively to HIV/AIDS.

Adult literacy is assumed to increase to a maximum of 95% in 2021 by applying an averaged five-year increase of 11.48%. The rate of increase was calculated as an average of the five-year increase according to population estimates of Statistics South Africa and according to the ASSA2002 model calculated between 1996 and 2001. Single year adult literacy values were interpolated using linear interpolation.

3.3.2.3 Impact of HIV/AIDS on income

Gross domestic product (GDP) per capita expressed in dollar purchasing power parities (PPP$) is used as a measure of income. "Purchasing power parity basically measures the number of units of a country's currency required to buy the same amount of goods and services (in the domestic market) that one dollar would buy in the United States of America" Statistics South Africa (2001: 21).

The sickness and eventual death of economically active individuals will contribute to an erosion of personal savings to cater for medical needs, increased government spending on

health care and social infrastructure like orphanages and on providing AIDS drugs and treatment will contribute to a reduction in the rate of growth of GDP (Bonnel 2000, Bureau for Economic Research 2000). However the impact of HIV/AIDS on GDP per capita is not that clearly stated, as the Bureau for Economic Research (2000) argue:

> Should we only account for the direct potential loss of labour supply and production, the impact on population growth (demographic) is likely to exceed the impact on economic production (GDP), implying a rise in per capita GDP. …However, when we account for the loss in productivity associated with the loss of labour and management skills and the shift from savings/investment to health care spending, the GDP impact is likely to exceed the demographic impact, i.e. per capita incomes decline (2000: 16).

Therefore for purposes of this research the GDP per capita of the black/Africans for 1996 will be assumed to be constant at the value calculated by Statistics South Africa (2001).

HIV/AIDS is expected to impact the demographic transition of the black/African population. The expected impact of the pandemic of the demographic transition will be determined by forward projections of elements of the demographic transition until 2021. In this chapter, key HIV assumptions of the ASSA2002 model were discussed. Calibrated according to projected trends in antenatal survey HIV prevalence, the model makes assumptions on HIV transmission dynamics among the black/Africans. Hence mortality and fertility projections will be obtained from the ASSA2002 model. Assumptions of the impact of HIV/AIDS on modernization were also discussed. The UNDPs human development index was assumed as an estimate of modernization.

The assumptions stated in this chapter are considered the most likely. However population projections are only a possible scenario in the future based on assumptions stated by the author. Assumptions of the ASSA2002 model of the ASSA AIDS Committee were accepted as the most likely assumptions; hence the model was run without changing any assumptions. However caution should be taken when interpreting population projection results. Population projections provide a scenario of the future under certain assumptions, they do not purport to predict the future but provide possible, probable projections.

Results of projections of mortality rates, fertility rates, the human development index and consequently the AIDS transition will be provided in chapter four.

Chapter four

The AIDS Transition

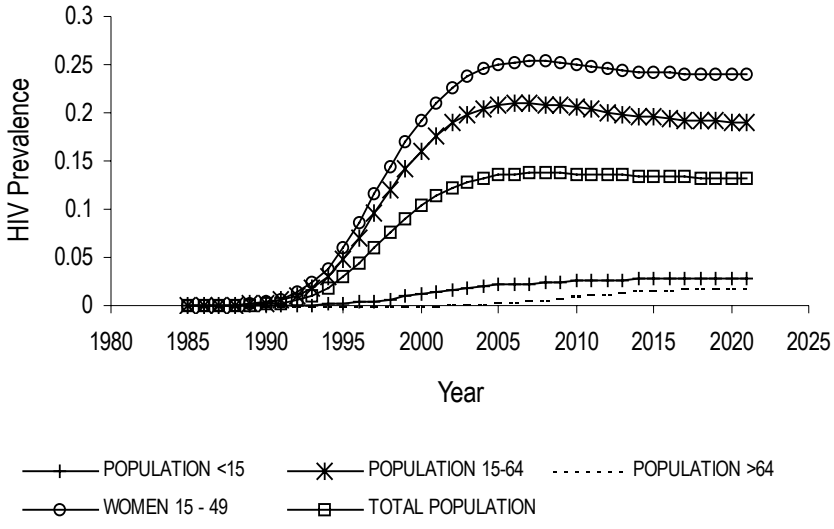
4.1 Introduction

This chapter discusses the projected impact of HIV/AIDS on mortality rates, fertility rates and the human development index of black/Africans by 2021 under methodological assumptions stated in chapter three. The projections of mortality, fertility the human development index lead to the projected impact of HIV/AIDS on the demographic transition of black/Africans. A comparison of the demographic transition in an AIDS and a no AIDS scenario illustrates the impact of HIV/AIDS thus indicating towards the introduction of an AIDS transition model.

4.2 The HIV/AIDS pandemic

The ASSA2002 model projects that HIV prevalence in the total population will peak in 2008 at a prevalence of 13.73%. However HIV prevalence is varied across age groups (Figure 4.1).

Figure 4.1: ASSA2002 projected HIV prevalence by age group: 1985 to 2021.



Source: ASSA2002

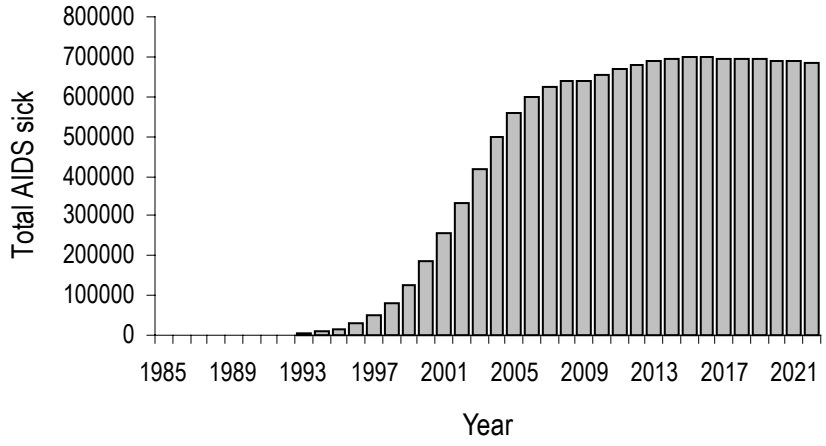
Individuals aged 65 years and older are projected to have the lowest HIV prevalence, peaking at a rate of 1.78% in 2019. This is attributed to the assumption in the ASSA2002 model of no HIV infections occurring after the age of 60. The age group 15 years and below is expected to have a higher prevalence than those aged 65 years and older as a result of mother-to-child transmission. HIV prevalence of individuals 15 years and younger is expected to increase for the entire study period; however increments of less than one percentage are projected from 2014 to 2021, with slight fluctuations between 2016 and 2017. HIV prevalence of those 15 and younger is estimated at 2.74% in 2021.

The functional group aged 15 to 64 years is projected to have a higher HIV prevalence than the total population (Figure 4.1). HIV prevalence among this age group (15 to 64) will peak in 2007 at a rate of 20.93%. Those aged 15 to 64 years can be defined as the economically active or potentially active group; therefore by affecting the economically active group HIV/AIDS is expected to disrupt financial arrangements in households. Females of reproductive age are however projected as the age group with the highest HIV prevalence among the black/Africans. HIV prevalence is projected to peak in 2007 (as those aged 15 to 64) but at a higher level of 25.36%. The Nelson Mandela/HSRC study of HIV/AIDS (2002: 58), state that, "The logistic regression analysis confirms that both age, in particular being between 25 and 49 years, and being female increases the likelihood of a person being HIV positive." Gender inequality is attributed as one of the reasons for the higher prevalence as women have little control over their sexual and reproductive health (Johnson and Budlender 2002: 9). HIV prevalence of those aged 15 to 64 years is projected to peak at a level 52.48% higher than the total population prevalence, whilst prevalence of women in reproductive ages will peak at a level 84.71% higher than the total population prevalence.

Based on functional age group definitions, those younger than 15 and older than 64 years are dependents, being dependent on the economically active or potentially active aged 15 to 64 years, the dependants are projected to be affected less by HIV/AIDS than the economically active group. The ratio of dependents to the economically active is projected to increase due to the impact of HIV/AIDS.

AIDS sick individuals in the total population will peak in 2016 with almost 700,000 (697,756) AIDS sick black/Africans (Figure 4.2).

Figure 4.2: Total AIDS sick black/Africans: 1985 to 2021



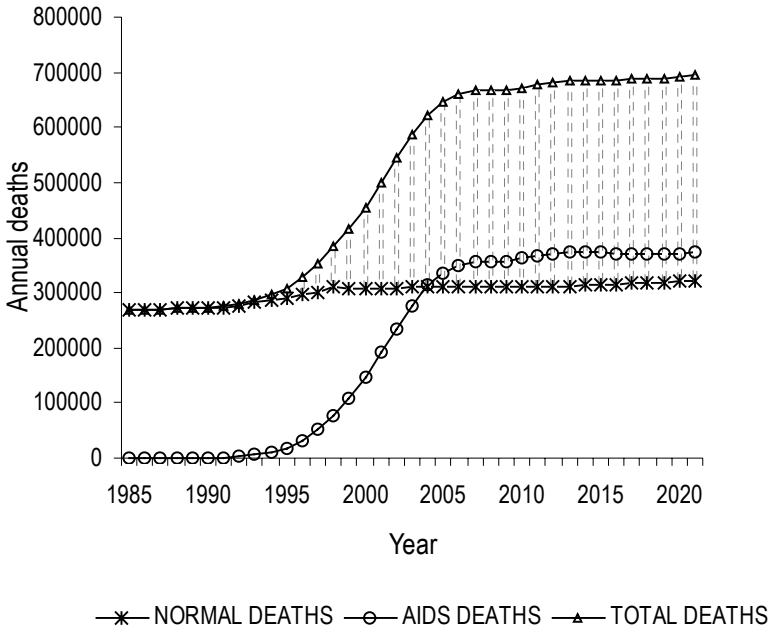
Source: ASSA 2002

4.3 Projected impact of HIV/AIDS on mortality and fertility rates

4.3.1 Mortality projections

Normal deaths (no-AIDS deaths) constituted the bulk of total deaths from 1985 to 1992. AIDS deaths accounted for less than one percent of total deaths in the same period. However, rising HIV prevalence within the black/African population is increasing total deaths, and AIDS deaths are estimated to surpass normal deaths in 2004 (Figure 4.3). The increment in total deaths due to AIDS deaths is highlighted between the total deaths trend line and the normal deaths trend. AIDS deaths are projected to constitute 54% of total deaths from 2013 to the end of the period in 2021. In a no-AIDS scenario total deaths would have been approximately constant during the entire period of study at around 300,000 deaths. However total deaths will be increased by 115.79% in 2021 due to the impact of HIV/AIDS of increasing mortality.

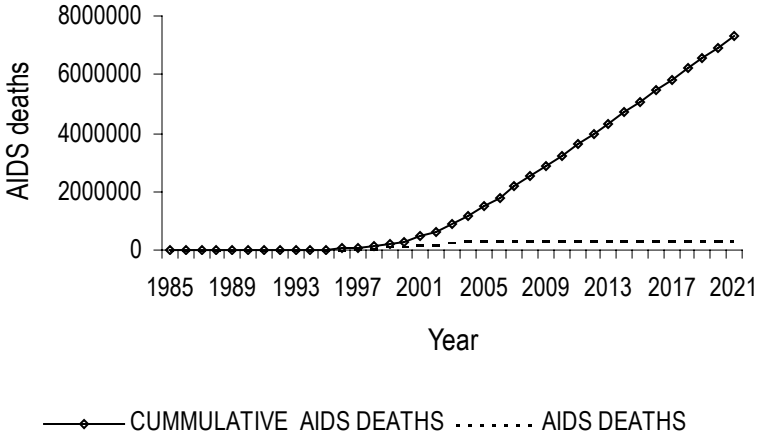
Figure 4.3: Normal deaths, AIDS deaths and total deaths of black/Africans: 1985 to 2021.



Source: ASSA2002

Cumulative AIDS deaths in 2021 will amount to just above seven million deaths, exactly 7,297,274 deaths (Figure 4.4). The total black/African South African population is currently estimated at 35,833,419 (ASSA2002). Therefore cumulative AIDS deaths will amount to a reduction of 20.36% of the current black/African population by 2021.

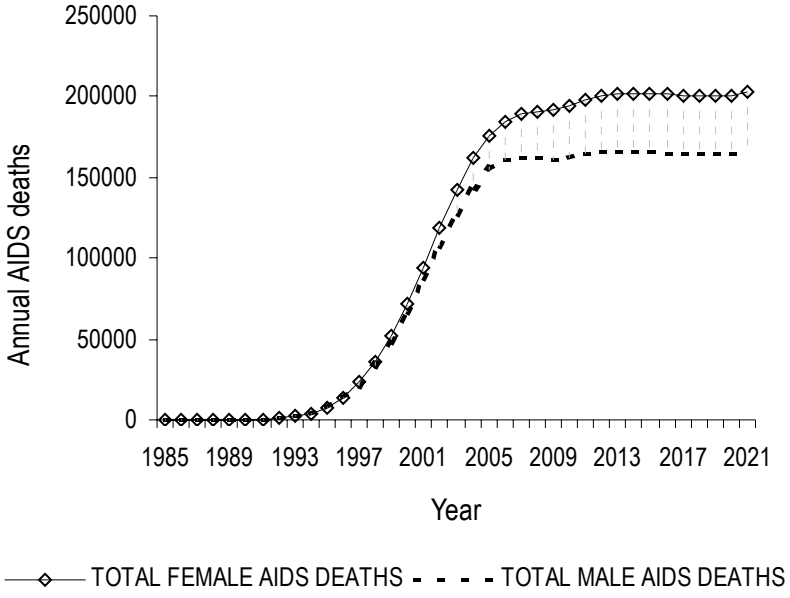
Figure 4.4: Annual and cumulative AIDS deaths of black/Africans: 1985 to 2021.



Source: ASSA2002

However females are projected to experience more annual AIDS deaths compared to males during the study period (Figure 4.5). Female AIDS deaths are estimated to be 22% more than male deaths in 2021 due to the higher HIV prevalence among women especially those of reproductive age. The extra AIDS mortality among females is shaded in figure 4.5.

Figure 4.5: Annual male and female AIDS deaths: 1985 to 2021.

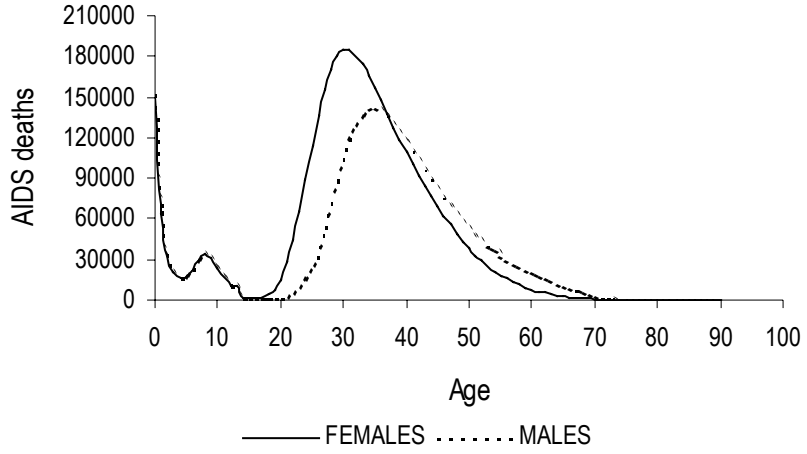


Source: ASSA2002

To determine the single age patterns of AIDS deaths across sex, AIDS deaths were summed across single ages from 1985 to 2021 (Figure 4.6). The trend in AIDS deaths across ages is similar for both males and females with differences exhibited in AIDS mortality peak ages and in the scale of AIDS deaths. Mother-to-child transmission is reflected in the relatively high AIDS deaths of male and female infants aged 0 and 1. The increased deaths of infants under one year will increase the infant mortality rate, taken as the number of deaths under one year divided by the number of live births in that year (Figure 4.7). The rate of infant mortality is used as an indicator of progress through the demographic transition model and its reduction indicates a reversal in the progress. Infant mortality rates are estimated to have increased to a high of 73. 22 per 1000 live births in 2000 from the impact of HIV/AIDS, a rate estimated in the late 1970s, thus reversing progress made in the past stages of the

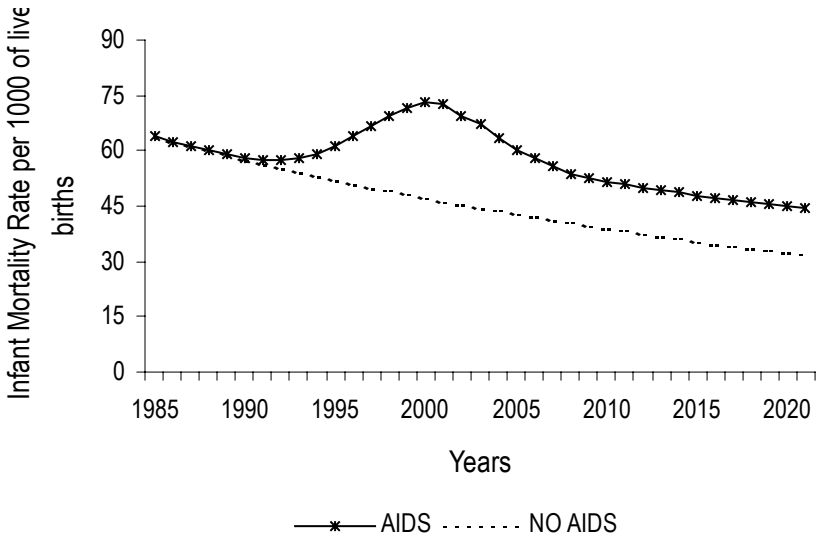
demographic transition (Figure 4.7). Returning to the AIDS deaths by age and sex, distinct differences in the pattern of AIDS deaths across sexes are observed from the age of 15 and older (Figure 4.6).

Figure 4.6: Male and female AIDS deaths by age: 1985 to 2021.



Source: ASSA2002

Figure 4.7: Infant mortality rates in an AIDS and no AIDS scenario: 1985 to 2021.



Source: ASSA2002

The highest female AIDS deaths are projected to occur at age 30; with cumulative AIDS deaths of 184,503 by 2021. Females aged 28 to 34 are projected to have the highest AIDS deaths in the range of 166,063 to 184,503. Male adult deaths in contrast are projected to peak in an older age range between the ages of 34 to 36 years with total deaths by 2021 ranging from 140,589 to 142,000. The highest number of male deaths is projected to occur at age 0 with AIDS deaths amounting to 150,199. Otherwise male adult AIDS deaths peak at age 35 with cumulative deaths of 142,000 by 2021.

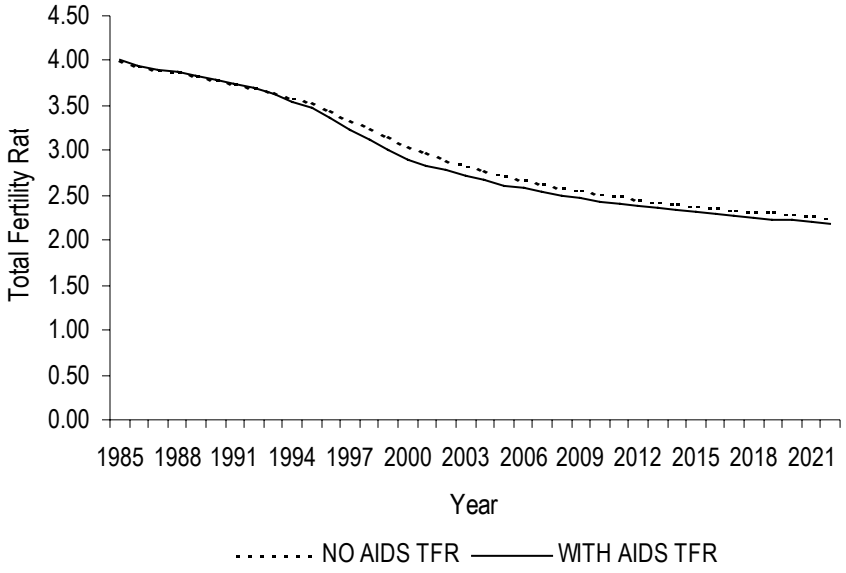
The higher HIV prevalence estimated for women aged 15 to 49 results in higher female deaths projected in the reproductive ages (Figure 4.6). Females of reproductive age are one of the main determinants of the fertility transition within the demographic transition, and are projected to account for 82% of total female AIDS deaths by 2021. The next section discusses the projected impact of the pandemic on fertility.

4.3.2 Fertility projections

The impact of HIV/AIDS on fertility will cause a slight reduction in fertility levels (Figure 4.8). A plot of fertility in a no-AIDS scenario against an AIDS scenario shows a fertility differential due to HIV/AIDS projected at a maximum just above 5% (5.09%) in 2000. Total fertility rates (TFR) are projected at rates of 2.21 compared to a no-AIDS scenario of 2.27 children per average woman in 2021. These levels of total fertility rates are close to the replacement level of 2.1 although HIV/AIDS is projected to slightly accelerate the fertility decline with a TFR of 2.64% lower than a no-AIDS scenario.

Fertility levels of black/Africans have been declining in line with the demographic transition theory and HIV/AIDS is projected to accelerate the fertility decline. However the fertility decline will be achieved through deaths of potential mothers and the fecundity reduction associated with the pandemic.

Figure 4.8: Total fertility rates in an AIDS and a no-AIDS scenario: 1985 to 2021



Source: ASSA2002

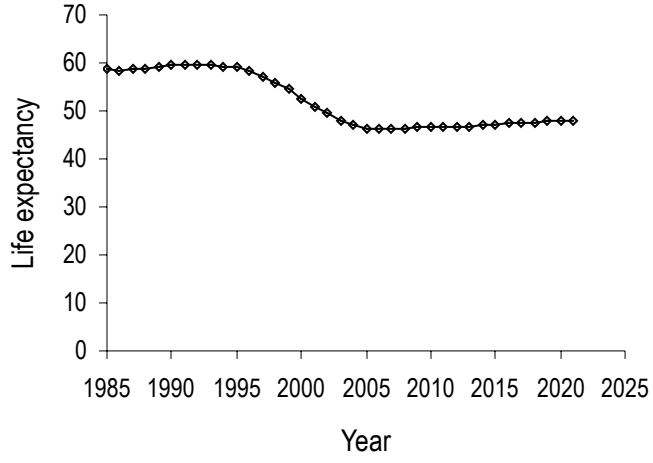
Results of the projected impact of HIV/AIDS on the human development index (taken as a measure of modernization of the demographic transition) are discussed in the following section.

4.4 Projected impact of HIV/AIDS on the human development index

4.4.1 Life expectancy

Life expectancy for black/Africans is estimated to have increased by 1.68% from 1985 to a value of 59.53 in 1992. Values of life expectancy declined from 1993 as a result of HIV/AIDS, from a value of 59.53 with the decline projected until 2006 to a value of 46.20. The steepest decline in life expectancy is estimated to have occurred between 1998 and 2004 declining from 55.63 to 47.01 with decrements ranging between 2.1% and 3.2%. Increases of less than 0.5% are projected from 2007 onwards with a life expectancy of 48.03 years projected for 2021 (Figure 4.9).

Figure 4.9: Life expectancy values projected from 1985 to 2021.



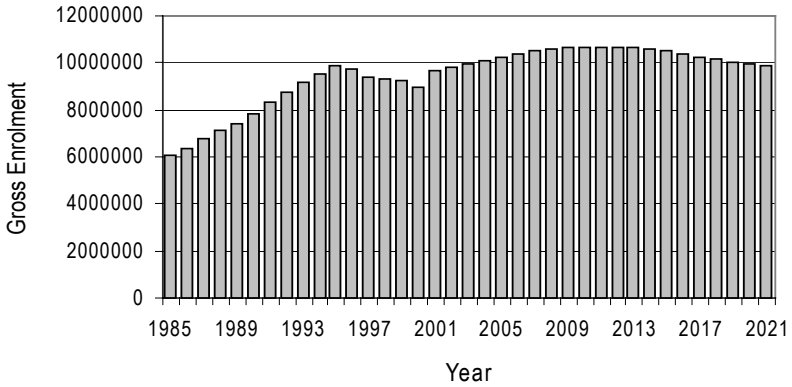
Source: ASSA2002

4.4.2 Education attainment

4.4.2.1 Gross primary, secondary and tertiary enrolment

Gross primary, secondary and tertiary enrolment is expected to increase by 10% between 2001 and 2011 from 9,703,658 to a total above 10 million (10,662,893). Thereafter total enrolment is projected to decline until 2021 by 7% due to the decline in primary school enrolment, which makes up the bulk of gross enrolment (Figure 4.10).

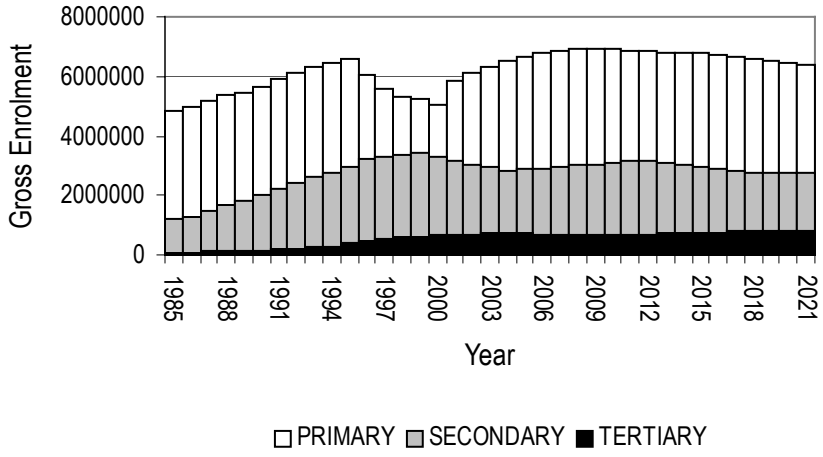
Figure 4.10: Gross primary, secondary and tertiary enrolment for black/Africans projected to 2021.



Gross primary enrolment is projected to increase from 2001 to a maximum gross enrolment in 2009 projected at 6,914,598, which translates into an 18% increase in gross enrolment (Figure 4.11). The marked primary enrolment increase from 2000 to 2001 is contributed by the estimation of gross primary enrolment ratio (GER) for black/Africans from the South African GER due to unavailability of data for black/African primary enrolment. From 2009 onwards, gross primary enrolment is projected to decline by 8.58% until 2021. The projected decline in primary gross enrolment is due to: (a) the decline of the official primary school age population from AIDS deaths (Figure 4.12) (b) reduced fertility levels and (c) the expected increase in the number of drop outs as the number of orphans under the age of 15 increases.

However once HIV prevalence in the total population peaks in 2013, declining HIV levels in the total population will result in reduced AIDS deaths of primary enrollers. Furthermore orphan numbers are projected to peak in 2015 and thereafter decline. The declining HIV prevalence and projected impacts of HIV/AIDS are expected to reduce drop outs, repetition rates and re-entry rates thus sustaining the reduction in gross enrolment from 2009 to 2021.

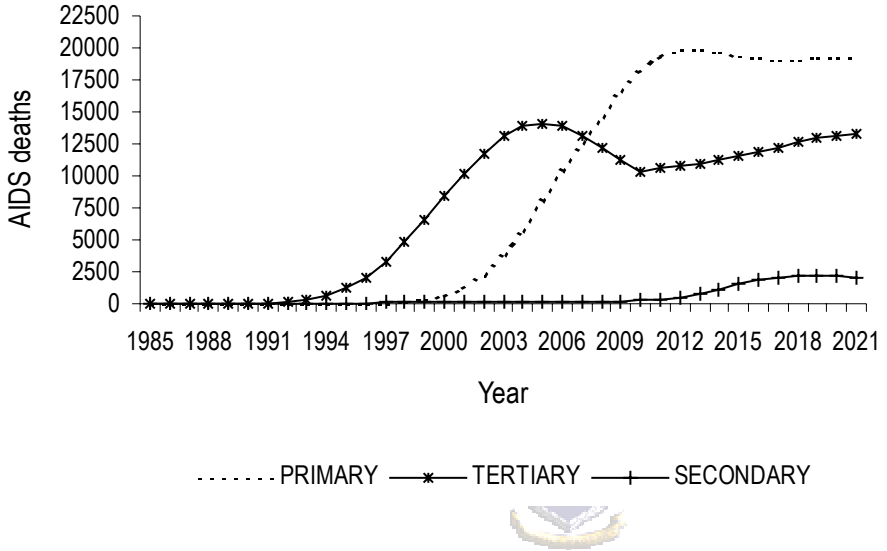
Figure 4.11: Gross primary, secondary and tertiary enrolment: 1985 to 2021.



Secondary gross enrolment is estimated to decline from 2001 due to the negative impact of HIV/AIDS projected to 2004. However, the increasing ASSA2002 official secondary age population increases from 2004 to 2013 thus influencing the increasing secondary gross

enrolment until 2012. From 2012 to 2021 secondary gross enrolment is projected to decline by 12% as a result of increased projected AIDS deaths of secondary school enrollers (Figure 4.12). An upward trend in gross tertiary enrolment is projected for the period of study except from 2005 to 2010 when the ASSA2002 tertiary aged population declines, causing a reduced tertiary enrolment of 9%.

Figure 4.12: AIDS deaths of officially aged primary, secondary and tertiary enrollers: 1985 to 2021.



Source: ASSA2002

The highest number of AIDS deaths are projected for primary enrollers (aged 7 to 13) due to mother-to-child transmission. An estimated 19,883 AIDS deaths of officially aged primary enrollers are projected to peak in 2013. Officially aged secondary enrollers (aged 14 to 18) have the lowest projected AIDS deaths estimated to peak at 2,219 deaths in 2019 at only 11.16% of primary AIDS deaths. AIDS deaths of tertiary enrollers increase from 1985 to peak in 2005 at 14,135. Tertiary AIDS deaths decline from 2005 until 2011 with deaths projected at 10,568 in 2011, then increase to 13,234 in 2021.

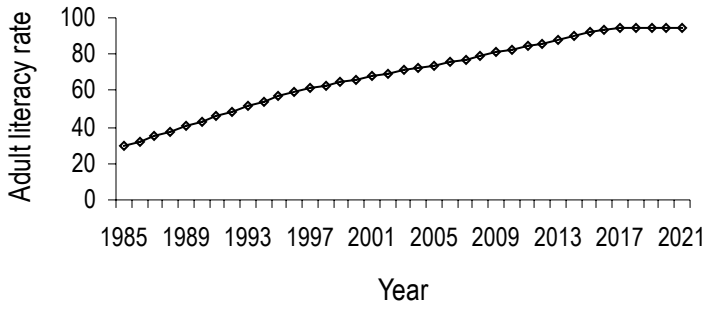
The projected pattern of primary AIDS deaths peaking in 2013, secondary AIDS deaths rising significantly after 2012 and AIDS deaths of officially aged tertiary enrollers peaking in 2005 then declining to rise again after 2012 (Figure 4.12) indicates the impact of prevention and treatment programmes modelled into the ASSA2002 model. The relatively low AIDS

deaths of secondary enrollers may be the result of the ASSA2002 assumption that HIV infection of those under the age of 13 years is either at birth or during breastfeeding.

4.4.2.2 Adult literacy rates

Adult literacy is estimated to increase from 28.84% in 1985 and projected to 95% in 2021.

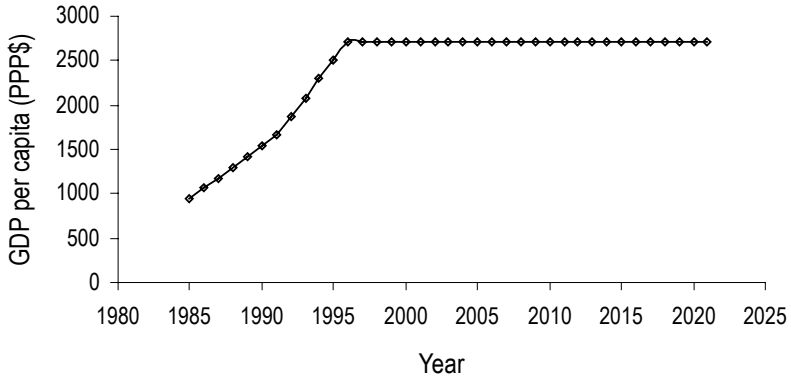
Figure 4.13: Adult literacy rates: 1985 to 2021.



4.4.3 GDP per capita

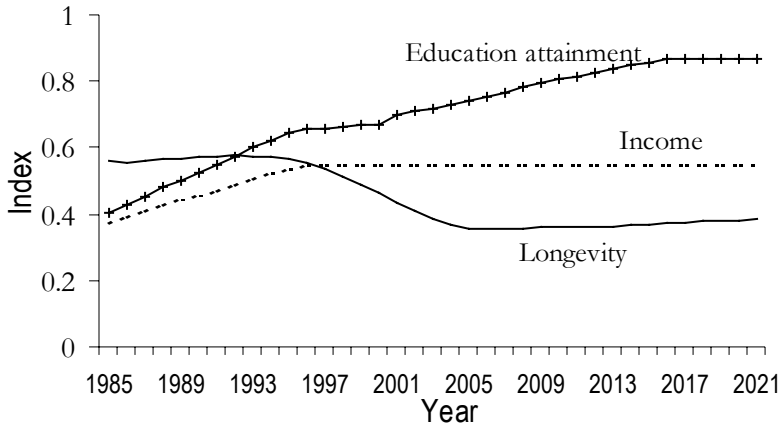
GDP per capita projections were assumed to be constant at a value of 2713 estimated as the 1996 GDP per capita value (Statistics South Africa 2001: 9).

Figure 4.14: GDP per capita values: 1985 to 2021.



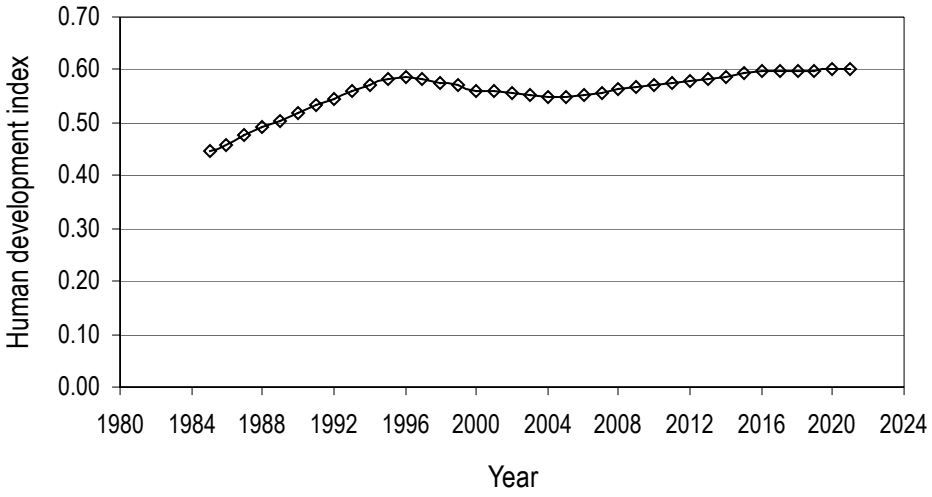
Indices of life expectancy, education attainment and GDP per capita were computed from 1985 to 2021 using the most recent recommended formulas by the UNDP (Formulas provided in Appendix II). Figure 4.15 provides a plot of the indices of the human development index.

Figure 4.15: Trends in the HDI components of the black/African population: 1985 to 2021



The education attainment index is projected to increase parallel to the decrease in life expectancy thus making up for the loss in human development as a result of the reduced life expectancy. The increased gross enrolment especially marked at primary school level is misleading since it increases the education attainment index thus moderating the reduction in the HDI. Net enrolment calculated as the number of enrollers of official school age divided by the total official school age population might be a better indicator to illustrate the impact of HIV/AIDS on enrolment. GDP per capita is assumed to not have a varying impact on the human development index from 1996 to 2021. Projections of the human development index for the black/Africans are provided in figure 4.16.

Figure 4.16: Projections of human development index for the black/African: 1985 to 2021.



The human development index of the black/African population is projected to decline by 5.51% from 0.581 to 0.549 between 1997 and 2004. The increase in HDI from 2004 to 2021 is projected at less than 1% compared to an average HDI increase of 2.54% per annum in the 1980s and early 1990s. Levels of human development estimated for 2004 are similar to levels observed in 1992; therefore under the assumptions of this study, HIV/AIDS will cause more than a decade reversal in levels of human development.

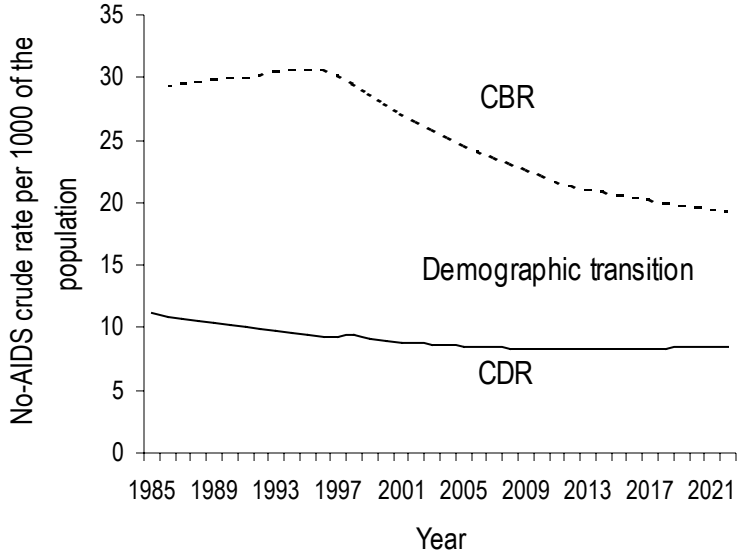
Levels of HIV prevalence projected by the ASSA2002 model determine the impact of HIV/AIDS on the human development index. The level at which HIV prevalence plateaus in the ASSA2002 model, is determined largely by the percentage of black/Africans in the NOT group, assumed to not be at risk of HIV infection. The ASSA AIDS Committee assumes that 48.8% of black/Africans constitute the NOT group. An analysis was conducted by varying the percentage of the NOT group to investigate the impact of the varied assumption on HIV prevalence and on projections of the human development index (Appendix I). However the assumption of 48.8% was accepted in this study as the most likely.

Projections of mortality, fertility and the human development index discussed above will be used to illustrate the impact of HIV/AIDS on the demographic transition of the black/Africans and determine the AIDS transition.

4.5 The AIDS transition

In a no-AIDS era the demographic transition model of the black/African was projected as figure 4.17. Crude rates of mortality and fertility were projected to decline as the black/African population progressed through their demographic transition. Fertility and mortality rates were estimated to be at current levels (2004) 25.27 and 8.60 per 1000 of the population respectively and projected to decline to fertility and mortality rates of 19.48 and 8.50 per 1000 of the population respectively in 2021. The mortality rate was expected to increase slightly from 2012 to 2021 as a result of anticipated population ageing, as the black/African population progressed their demographic transition (Figure 4.17).

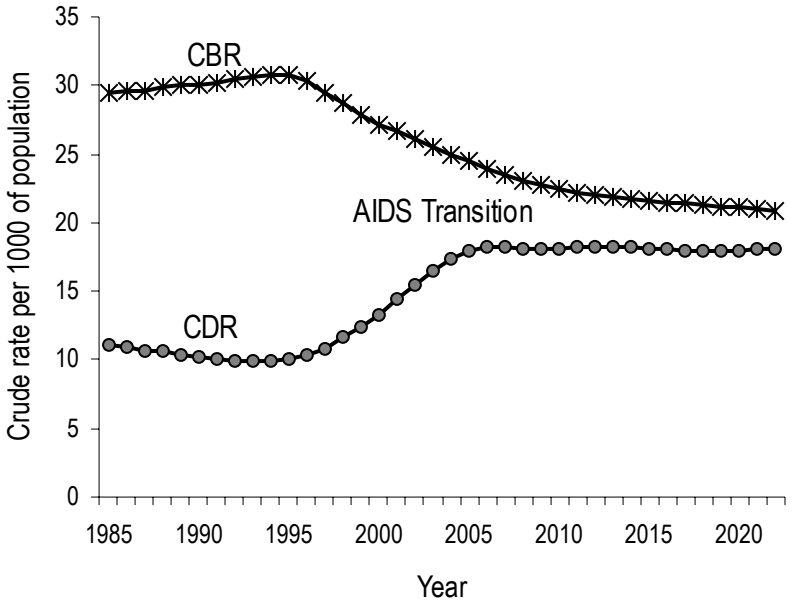
Figure 4.17: Projected no-AIDS scenario demographic transition over time: 1985-2021.



Source: ASSA2002

However as discussed in the preceding section, mortality has been increasing since 1994 from crude rates of 9.95 per 1000 of the population and projected to increase to levels of 18.24 per 1000 of the population in 2007. HIV/AIDS will increase crude death rates within the 13-year period from 1994 to 2007 by 83%. Currently crude death rates are estimated at 17.38 per 1000 of the population. Mortality rates are expected to fluctuate from 2008 to 2021 from rates of 18.14 to 18.02 per 1000 of the population, with increments and decrements of below 1% (Figure 4.18).

Figure 4.18: The AIDS transition plotted over time: 1985 to 2021.



Source: ASSA2002

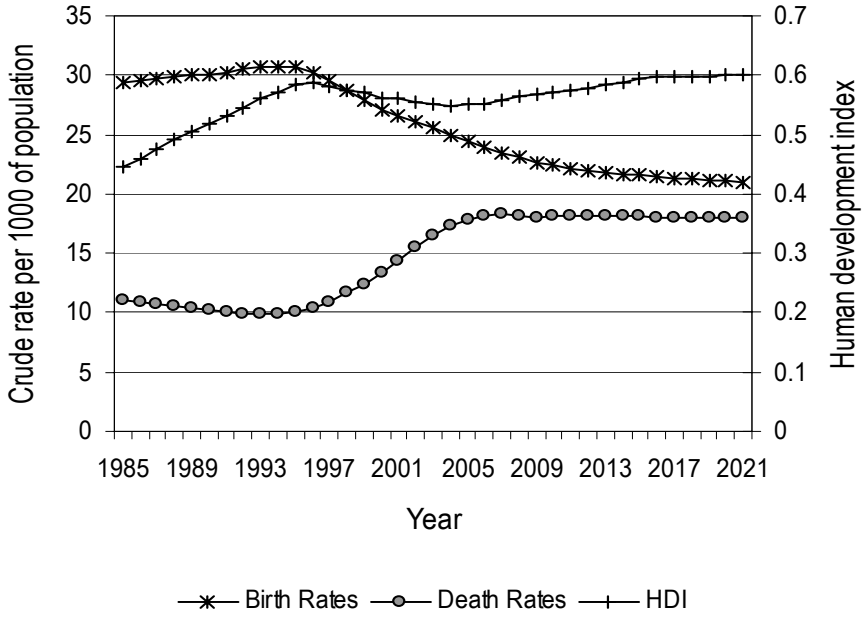
The fertility decline postulated by the demographic transition model will be slightly accelerated from the impact of HIV/AIDS with a TFR 2.64% lower in an AIDS scenario relative to a no-AIDS case. Crude rates of fertility are expected to continually decline from current levels of 24.97 live births per 1000 of the population, to a rate of 21.01 live births per 1000 of the population in 2021. A comparison of the crude birth rates in an AIDS (21.01) and no-AIDS (19.48) scenario shows that the crude rate in a no-AIDS scenario is less. The crude birth rate in a no-AIDS scenario may be lesser because increased AIDS related deaths will reduce the black/African population, and as crude fertility is calculated as the number of live births per specific year divided by the midyear population estimate for that year, the

denominator (population estimate) will be lower thus translating to a higher crude birth rate compared to a no-AIDS scenario. However when the TFR is used, the number of children per average woman is slightly lower due to HIV/AIDS, estimated at 2.21 compared to a no-AIDS estimate of 2.27 children per average woman.

HIV/AIDS is projected to increase mortality levels; a contradiction of the classic demographic transition and at the same time slightly accelerate the fertility decline; a favourable condition of the demographic transition model. HIV/AIDS is projected to alter the demographic transition model of the black/Africans by 2021 (Figure 4.18). Therefore it may be more appropriate to introduce a more appropriate term to account for the disruption in transition as a result of HIV/AIDS: the AIDS transition.

The demographic transition theory supposes a progression in transition levels with increasing levels of modernization. HIV/AIDS is expected to affect mortality rates, fertility rates and processes of modernization. The AIDS transition will be plotted alongside human development index projections.

Figure 4.19: The AIDS transition plotted alongside human development index projections over time: 1985 to 2021.

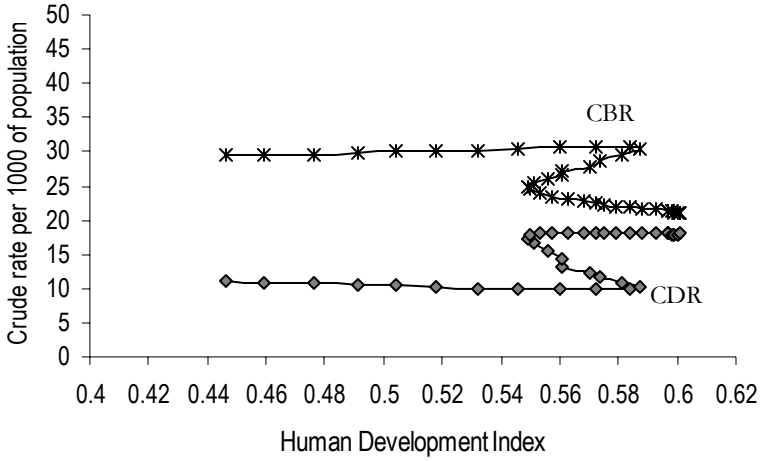


Source: ASSA2002 model for CBR and CDR

Levels of human development index were increasing with declining mortality and fertility rates, a condition of the demographic transition (Figure 4.19). However the dual impact of HIV/AIDS on components of the demographic transition is evident from 1996 to 2004 with the human development index decreasing whilst mortality rates increased and (although not evident from figure 4.19) fertility levels were slightly accelerated in their decline. Human development index levels reduced from 0.58 to 0.55 between 1996 and 2004, whilst mortality increased from 10.34 per 1000 of the population to 17.38 per 1000 in 2004 and fertility levels declined from 30.26 to 24.96 per 1000 of the population.

Assuming that the relationship between the human development index (a measure of modernization) with mortality and fertility rates is a direct causality, the HDI as the independent variable and crude rates of mortality and fertility as dependent variables, figure 4.20 was plotted. Figure 4.20 illustrates the simultaneous impact of HIV/AIDS on elements of the demographic transition assuming the HDI (modernization) as a single causality factor and as a predictor of mortality and fertility rates. However assuming modernization as the sole instigator of the demographic transition has been disputed (chapter two), nevertheless figure 4.20 will be used for illustration purposes.

Figure 4.20: Mortality and fertility rates plotted vs. the human development index: 1985 to 2021



Source: ASSA2002 model

The estimated decline in HDI levels reversed the unidirectional trend in mortality and fertility rates from 1996 to 2004. As the pandemic recedes, HDI levels increase to 0.60 in 2021 and a positive trend in the transition components is regained. Mortality levels are projected at almost constant levels from 2005 fluctuating to a rate of 18.02 in 2021. Fertility levels declined to 21.01 live births per 1000 in 2021.

In this chapter, results of HIV/AIDS and its projected impact on mortality rates, fertility rates and the human development index culminated into the impact of HIV/AIDS on the demographic transition of black/Africans. The impact of the pandemic is projected to alter the demographic transition of the black/African population by 2021. Although not to disregard the classic demographic transition theory, the higher HIV prevalence within the black/African population necessitates an adjustment of the classic demographic transition theory to account for the impact of HIV/AIDS. Therefore it may be more appropriate to speak of an AIDS transition in this era of HIV/AIDS. Implications of the AIDS transition will be discussed in the following chapter.

Chapter five

Demographic implications of the AIDS transition

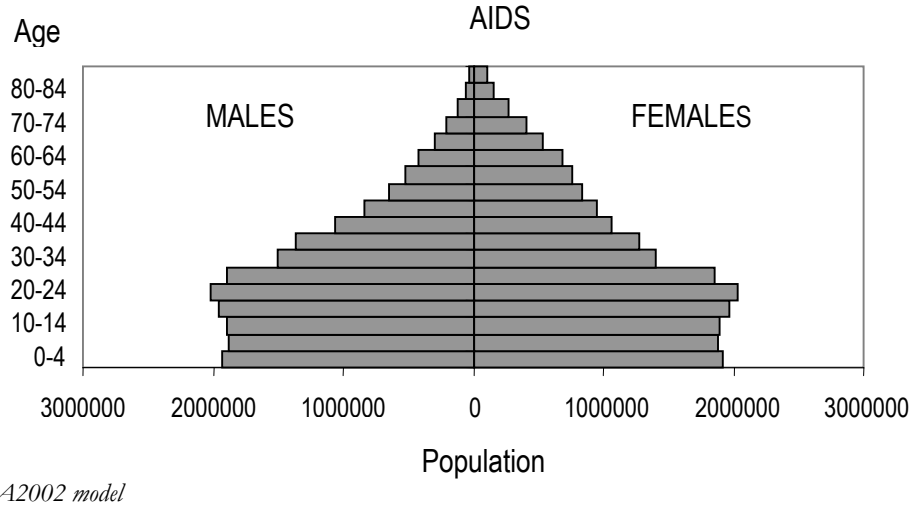
5.1 Introduction

The AIDS transition has been introduced and recommended as an appropriate term to account for the impact of HIV/AIDS on the demographic transition of black/Africans in the preceding chapter. In this chapter the demographic implications of the AIDS transition will be discussed. The projected age and sex structure of the black/African population in 2021 is discussed in the first section. The last section will discuss possible implications of the AIDS transition on the future demographic transition of black/Africans.

5.2 Population age and sex structure

The total black/African population is projected to be 38,630,248 in 2021 compared to a population of 46,293,156 in the absence of HIV/AIDS, a 17% reduction due to HIV/AIDS impacts. The population pyramid of population totals projected for 2021 indicates a declining young population as reflected by the concave shape in the ages 5 to 19 years (Figure 5.1).

Figure 5.1: Projected population pyramid of population totals for black/Africans in 2021.

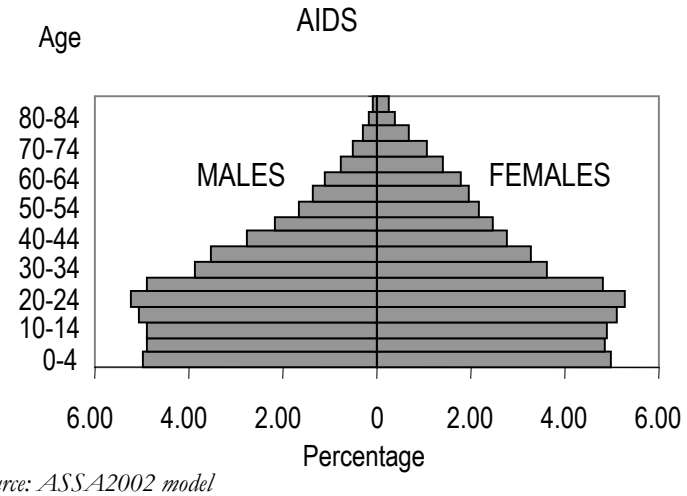


Source: ASSA2002 model

This concave shape is a result of the relatively high proportion of AIDS deaths projected amongst those below 5, particularly those aged 0 and 1. As HIV prevalence in the population recedes and subsequently AIDS deaths decline, the population aged 0-4 is observed to increase. Differences in the age structure resulting from age variations in AIDS deaths across males and females can be seen from the population pyramid. Males aged 30-34 are just over one and a half million (1,501,652) with females totalling 1,401,230. In the 35-39 age group males are also approximately 100 000 more than females. Population totals in the age groups 45 years and older are higher for females relative to males, as a result of mainly male AIDS deaths projected to occur in the older ages. Females 45 years and older are projected to constitute 12.19% of the total population, whilst males in the same age group are 8.12% of the total population.

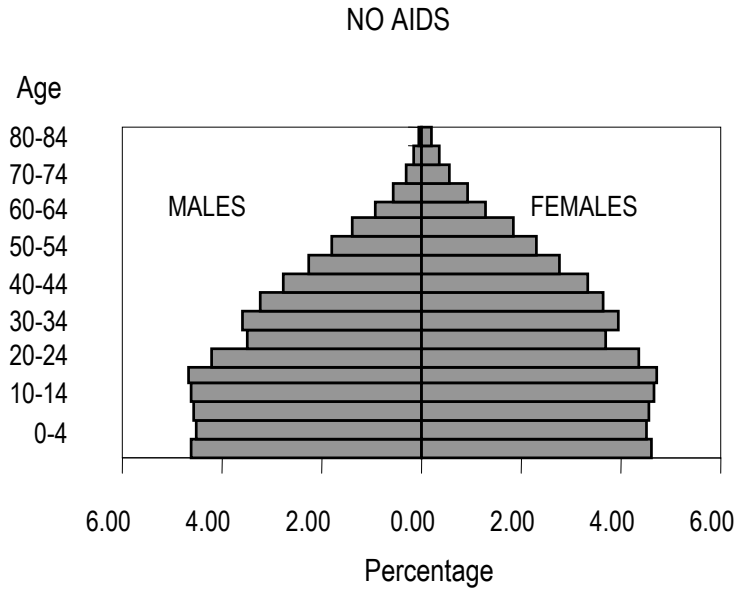
The shape of the population (percentage distribution) projected for 2021 is illustrated in figure 5.2. When the population pyramid projected for 2021 is compared to a no-AIDS pyramid for the same year (Figures 5.2 and 5.3), the decline in the young population is comparable in both pyramids. The projected no-AIDS population pyramid has an 'onion' and sort of 'barrel' shape typical of countries in the fertility decline stage of the demographic transition. In contrast, the projected AIDS population pyramid has a more defined 'onion' shape in the younger ages (from AIDS deaths and AIDS related fertility decline), however the structure of the older age categories is distorted and different from the typical 'onion' shape (Figure 5.3) as a result of AIDS related deaths.

Figure 5.2: Projected population pyramid showing percentage distribution in 2021.



Source: ASSA2002 model

Figure 5.3: Projected population pyramid showing percentage distribution in 2021 in a no-AIDS scenario.



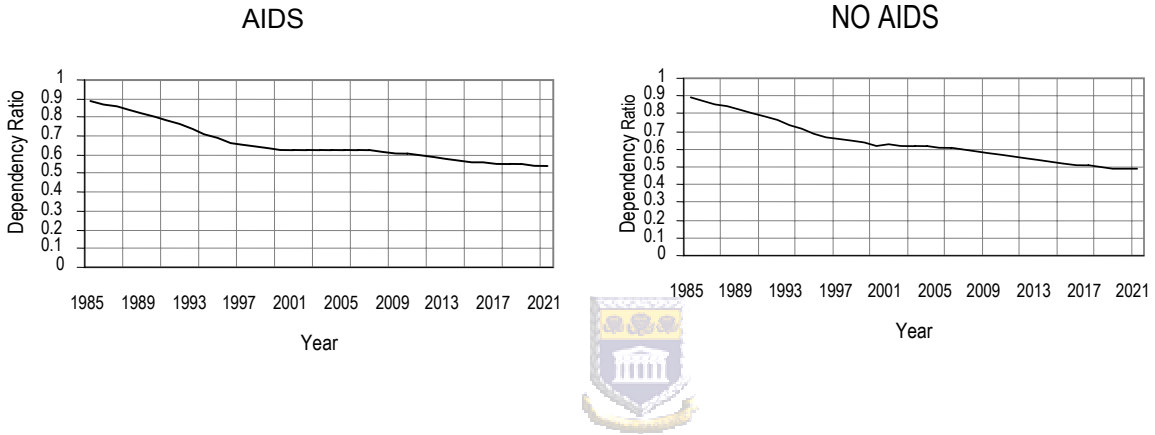
Source: ASSA2002 model

The relatively higher proportion of AIDS deaths of those aged five years and below and of adults aged 25 to 45 accounts for the differences in the shape of the projected age structures in an AIDS and a no-AIDS scenario. As a result of AIDS deaths, the age group 20-24 is projected to be the most populous in 2021 estimated at 10.49% across males and females and therefore protrudes noticeably in figure 5.2 compared to the no-AIDS scenario. Although the projected population pyramid reflects an accelerated fertility decline, the older ages are less populous and reflect increased deaths as a result of HIV/AIDS, a variation from the typical population pyramid resulting from the demographic transition.

The proportion of the young (aged below 15) is projected to be 29.47% (11,385,920) in 2021, compared to a no-AIDS scenario of 27.38% (12,674,257). The potentially economically active group aged 15 to 64 years will comprise 64.88% (25,061,639) in 2021 relative to a proportion of 67.27% (31,140,518) in the absence of HIV/AIDS. The old age group 65 years and older is projected at a higher percentage of 5.65% (2,182,690) compared to a no-AIDS scenario of 5.35% (2,478,381). Therefore the impact of AIDS deaths among the potentially economically active can be noted in the reduced population of those 15 to 64

years relative to a no-AIDS scenario. The deaths of those aged 15 to 64 have an impact on the age dependency ratio in 2021. The dependency ratio is computed from the total of persons aged 15 years and younger with those 65 years and older, divided by the potentially economically active group aged 15 to 64. Figure 5.4 shows that the age dependency ratio will be higher as a result of AIDS deaths of the potentially economically active persons aged 15 to 64.

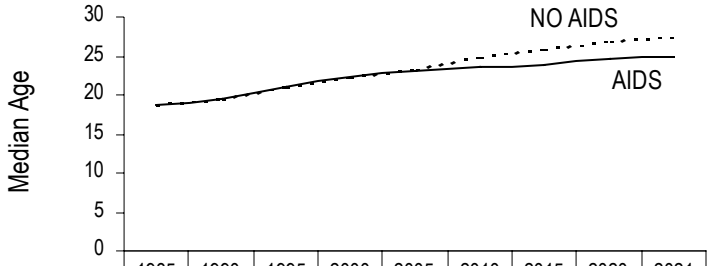
Figure 5.4: Dependency ratios of black/Africans in an AIDS and a no-AIDS scenario: 1985 to 2021.



Source: ASSA2002

The age dependency ratio is projected to be 0.54 in 2021 compared to 0.49 in a no-AIDS scenario, an increased age dependency of 10% due to HIV/AIDS. The black/African population is projected to be an intermediately aged population with a median age of 24.94 in 2021. The median age is the age at which the population is divided into two equal groups. The no-AIDS scenario median age is higher, estimated at 27.31 due to the higher proportion of persons aged 15 to 64 years (Figure 5.4).

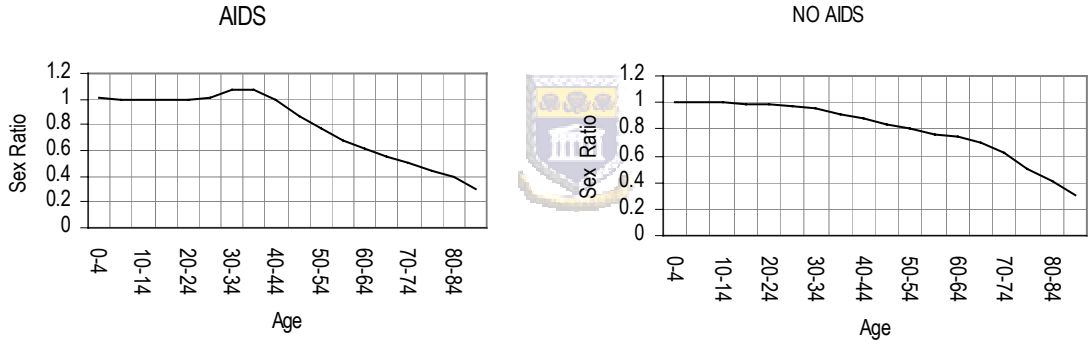
Figure 5.5: Median ages for an AIDS and a no-AIDS scenario: 1985 to 2021



	1985	1990	1995	2000	2005	2010	2015	2020	2021
AIDS	18.814	19.516	21.144	22.187	22.961	23.51	23.893	24.717	24.943
NO AIDS	18.814	19.516	21.142	22.232	23.425	24.836	25.773	27.031	27.314

Source: ASSA2002

Figure 5.6: Five-year age group sex ratios for black/Africans projected for 2021.



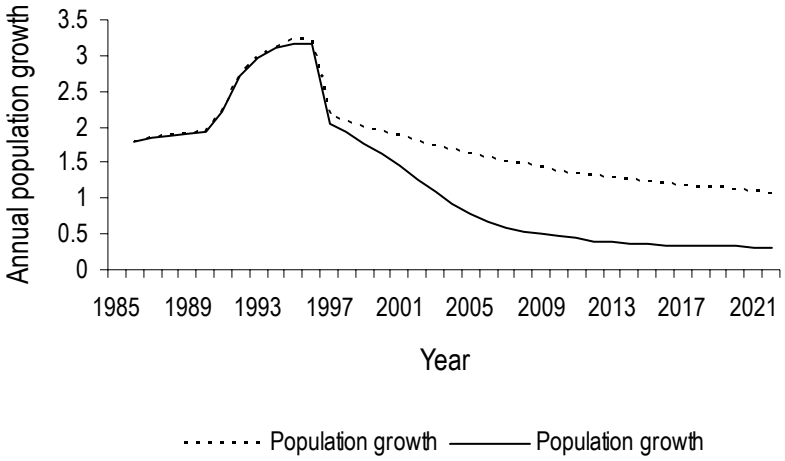
Source: ASSA2002

The sex ratio is interpreted as the number of males per females. An age specific sex ratio greater than one implies more males than females and inversely a sex ratio below one implies more females than males. The impact of AIDS mortality among females of reproductive age is evident from the higher numbers of males in the age group 20 to 44 years.

5.3 Population growth

The result of the increased mortality and slightly reduced fertility rates has implications for population growth. The demographic transition theory postulates that populations move from a period of stable population growth, through the transitional phase characterised by high population growth to post transitional phases of low and stable population growth.

Figure 5.7: Projected annual growth rates: 1985 to 2021



Source: ASSA2002 model

Figure 5.7 illustrates population growth projected for the period compared to a no-AIDS population growth. Population growth is projected to be lower than in the absence of AIDS as a result of increased mortality coupled with the slight fertility reduction. An annual growth rate of 0.3% is projected for 2021 compared to growth of 1.1% in a no-AIDS scenario. An almost 250% decline in population growth is projected as a result of the pandemic. Therefore the impact of HIV/AIDS will attain the transitional population growth, even at a faster rate than anticipated. However the lower population growth projected for the black/Africans will not be attained through increased modernization but rather through the unprogressive means of increased mortality.

5.4 Implications for the demographic transition

Mortality rates are projected at 18.02 per 1000 of the black/African population in 2021, whilst fertility rates are projected at 21.01 live births per 1000 of the population. The approximating fertility and mortality rates at the end of the AIDS transition resembles the pre-transitional stage the demographic transition model, prompting the question of how fertility and mortality rates are expected to behave afterwards. What are the implications of the AIDS transition on the future pattern of the classic demographic transition of the black/Africans?

The AIDS transition is expected to influence demographic patterns of black/Africans in two possible ways:

i. A continued demographic transition: A continuation of the interrupted demographic transition on completion of the AIDS transition. The receding pandemic will lower mortality levels, which combined with the fertility decline will complete the demographic transition of the black/Africans.

ii. A second demographic transition: A post-AIDS baby boom may increase fertility levels which coupled with decreasing mortality rates (from the receding pandemic) could result in a second demographic transition where fertility levels will eventually decline to fluctuate around low levels of mortality. Fertility aspirations may be higher with the receding pandemic, which may trigger a rise in family formation, early age at marriage and an increased number of children per average woman as the risk of HIV infection will be declining.

This chapter discussed the age and sex structure of the population in 2021, population growth, and possible implications of the AIDS transition on the classic demographic transition model. The following chapter concludes this research on the impact of HIV/AIDS on the demographic transition of black/Africans.

Chapter six

Conclusion

The nature of HIV/AIDS was contextualised within the progression of the demographic transition of the black/African population in the introduction. Mortality rates and fertility rates were on the decline, estimated at 8.1 per 1000 of the population and 34.9 live births per 1000 of the population respectively in the early 1980s (Mostert *et al* 1998: 76, 124). The decline in death and birth rates was expected to continue with progression of their demographic transition. However, research indicated that HIV/AIDS was increasing mortality and expected to accelerate the fertility decline. The research aimed to alter the classic demographic transition of the black/Africans to include the impact of HIV/AIDS using population projections of the ASSA2002 model.

The demographic transition theory was reviewed in chapter two. In spite of criticisms on the whether the theory was applicable to 'developing' or 'non-western' countries the demographic transition was shown to be applicable to the black/African population. Causality of the demographic transition was attributed to the various factors that had been put forward by scholars to explain the transition. No one factor was attributed for the demographic transition however modernization was taken as a principal causality factor of the demographic transition.

In chapter three, methodological assumptions of the ASSA2002 model and of the human development index (taken as a measure of modernization) were discussed. The ASSA2002 model is calibrated using estimates of antenatal clinic HIV prevalence. The ANC data however, has several limitations. The UNDPs human development index was used as a measure of modernization. The HDI has several computational including the fact that it is not an exhaustive measure of modernization.

Population projections of the black/Africans projected to 2021 illustrated that the pandemic would alter their demographic transition in chapter four. Mortality rates are projected to increase whilst fertility decline will be slightly accelerated. Levels of human development

index are projected to be simultaneously reduced and retarded by HIV/AIDS. Therefore the AIDS transition was introduced to account for the impact of HIV/AIDS on the demographic transition of the black/Africans.

The demographic transition theory does not account for the possibility of a reversal or acceleration in the trend of mortality or fertility rates and even in the levels of processes associated with the transition (like modernization). The prevalence of HIV within the black/African population is projected to alter their demographic transition, by reversing the mortality transition and accelerating the fertility decline. The impact of HIV/AIDS is expected to override the various causality factors of the demographic transition and is expected to alter mortality and fertility patterns. The AIDS transition is an appropriate term to account for the impact of HIV/AIDS.

Demographic implications of the AIDS transition were discussed in chapter five. The projected population pyramid in 2021 illustrated the impact of AIDS deaths with younger cohorts 'bit deeply' compared to a no AIDS scenario. The age dependency is projected to be higher as a result of AIDS deaths of the potentially economically active persons. Sex ratios of those ages 25 to 44 years will be more than one indicating more males than females as a result of the highest number of AIDS deaths projected among women aged 15 to 49. The median age of black/Africans in 2021 is projected to be an intermediate age. Population growth will be reduced sharply as a result of HIV/AIDS.

Possible implications of the AIDS transition on the classic demographic transition were also discussed in chapter five. Either the disrupted demographic transition will be continued after the AIDS transition or a second demographic transition will be observed. Whilst mortality rates can be expected to decline following the AIDS transition, fertility trends may not be easily discernible as behavioral changes as a result of the AIDS transition are expected to influence fertility trends. Further research is required to determine the impact of the AIDS transition on fertility aspirations of the black/African population.

Therefore projected values of mortality will reflect a reversal in modernization by 2021, yet on the contrary projected values of fertility are expected to signify positive gains in

modernization. These contrasting circumstances can neither be explained within the framework of the traditional three-staged demographic transition model postulating a unidirectional pattern of mortality and fertility nor the contemporary five-staged model allowing for a slight reversal in trend due to population ageing. In the former, mortality levels envisaged are too low and in the latter the extent of mortality increment falls short. The impact of HIV/AIDS calls for a more appropriate and relevant term to explain the projected demographic phenomenon: the AIDS transition. This research however does not purport to disregard the classic demographic transition theory, but rather adapt it to include the impact of HIV/AIDS.

Characterized by mortality patterns similar to those observed in the black/African population in the 1950s, and fertility rates projected with the meeting of millennium goals, the AIDS transition is paradoxical. The AIDS transition paradox, is one in which one of the identifiers of modernization is attained in the form of fertility decline and another, an indicator of a reversal in modernization in the form of mortality incline.

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Appendix I: Varying assumptions of the NOT group

The prevalence level at which HIV prevalence is projected to plateau is determined to a large extent by the proportion of the NOT group. The NOT group is assumed to be the percentage of the black/African population at no risk of acquiring HIV. To determine the impact of varying the NOT group on projections of the HDI, an analysis was conducted with the NOT percentage at:

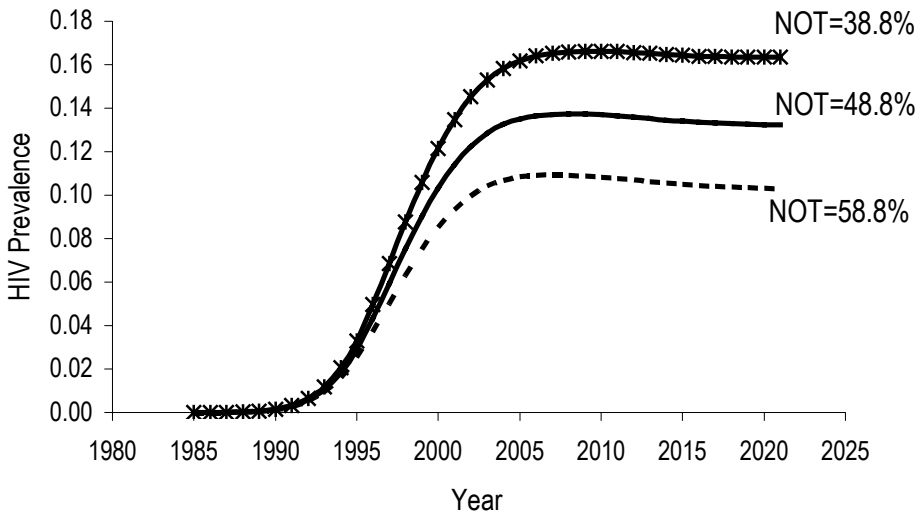
i. 38.8%: taken as the high impact of HIV/AIDS
ii. 48.8%: taken as the medium impact and the most likely impact as set by the ASSA AIDS Committee
iii. 58.8%: considered as the low impact of HIV/AIDS

The effect of varying the NOT group was to determine a change in one of the key HIV/AIDS assumptions; however the calibration estimates used by the ASSA2002 model would be affected in the analysis. Nevertheless since population projections are based on assumptions made, it is important for an analysis which presents projections under varying possible assumptions.

The number of projected primary school dropouts was estimated from the orphan totals provided with the NOT group at 48.8% (the most likely). For the high impact of HIV/AIDS (NOT=38.8%), a 30% drop out rate of the total annual orphans was used. Whilst for the low impact of HIV/AIDS (NOT =58.8%), an orphan drop out of 20% of the total annual orphans was used.

The total population HIV prevalence plateaus at a higher prevalence of 16.63% in 2010 when the proportion of the NOT group is set at 38.8%. On the other hand when the NOT group is increased to 58.8%, HIV prevalence plateaus at 10.94% in 2007. With the NOT group set at 48.8% (as assumed by the ASSA AIDS Committee), HIV prevalence peaks at 13.73% in 2008.

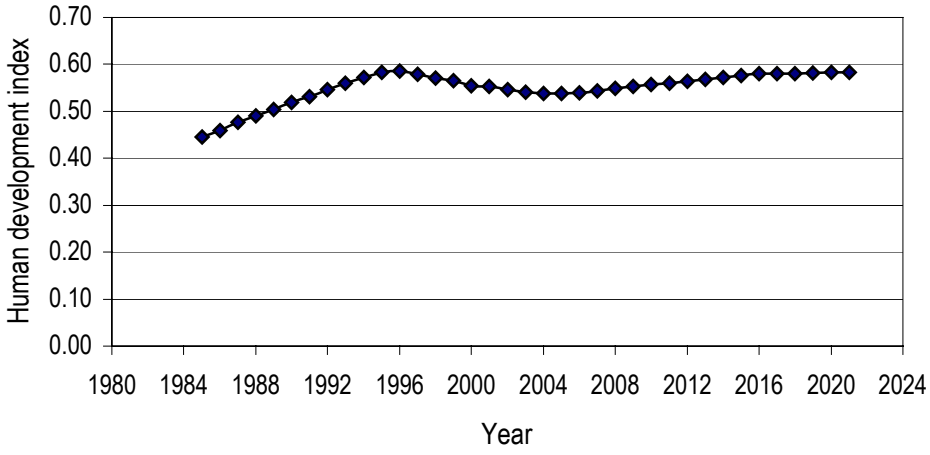
Total population prevalence from varying the percentage of the NOT group



Source: ASSA2002

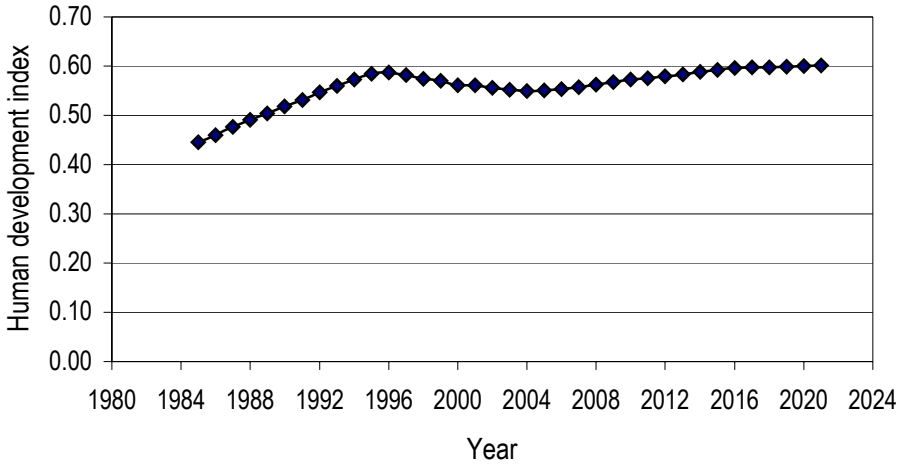
High, medium and low projections of the human development index are provided for the different assumptions of the NOT group. The NOT group percentage variations were titled either high, medium and low based on the relative impact of the assumptions.

High impact of HIV/AIDS (NOT = 38.8%)



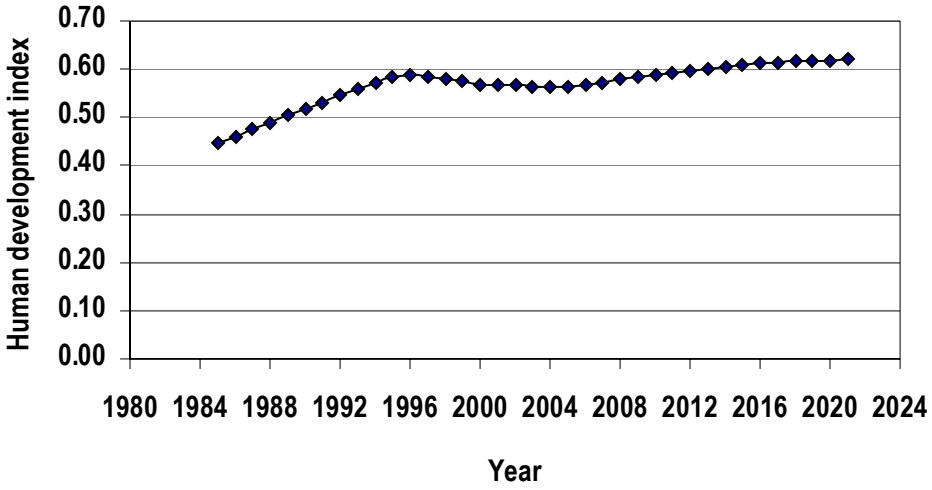
A high impact of HIV/AIDS will reduce the HDI to a minimum value of 0.538 in 2004 compared to an estimated minimum of 0.549 for a medium impact and 0.562 for a low impact of HIV/AIDS.

Medium impact of HIV/AIDS [The most likely] (NOT = 48.8%)



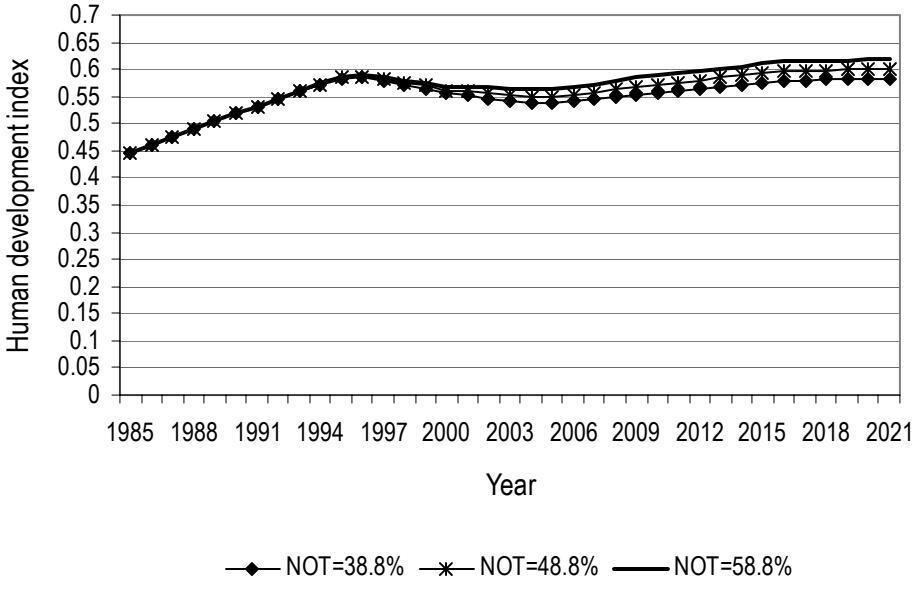
From 1996 to 2004, the period in which the human development index is estimated to decline as a result of the impact of HIV/AIDS, the high impact is estimated to result in a 8.92% reduction in the HDI; the medium impact is estimated to result in a 6.90% reduction in the HDI and the low impact of HIV/AIDS is estimated a relatively lower 4.80% reduction in the HDI.

Low impact of HIV/AIDS (NOT = 58.8%)

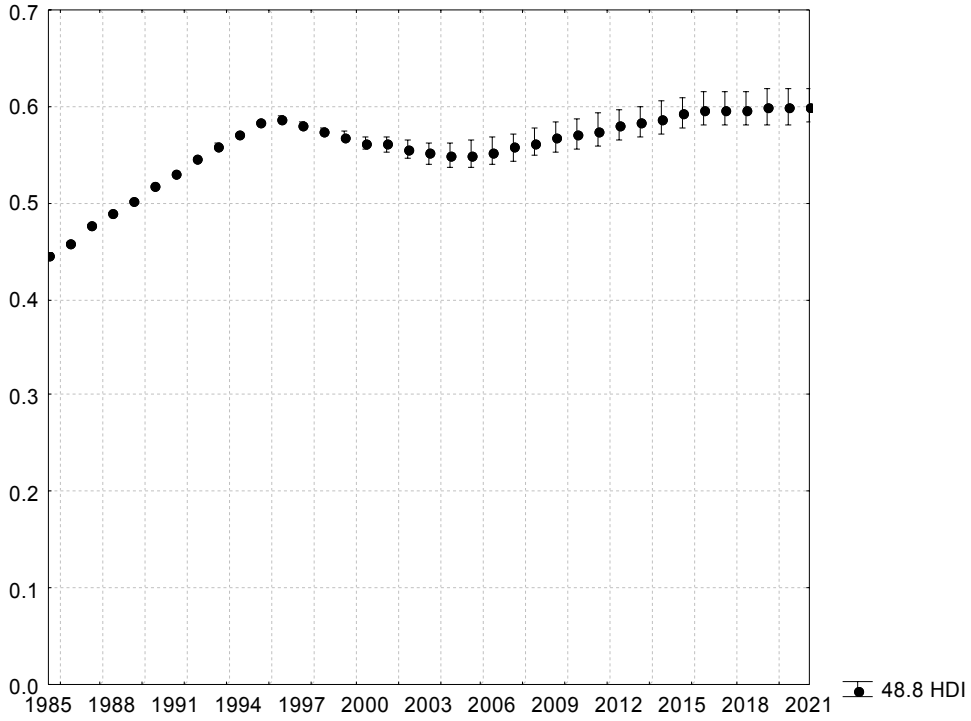


In 2021, the HDI value projected from a high impact of HIV/AIDS is 0.583, from a medium impact, 0.601 and from a low impact, 0.620. The medium impact will be at a 3% range of either the low or the high HDI projection.

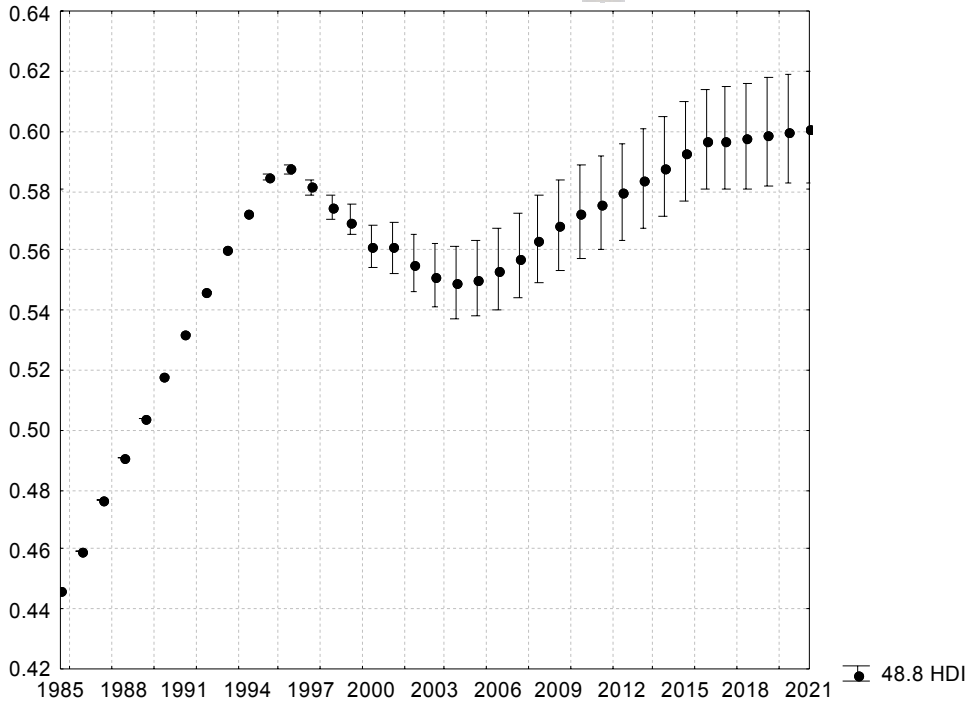
High, low and medium impact of HIV/AIDS



Range plot of high, medium and low projected impact of HIV/AIDS on the human development index with zero origin



Range plot of high, medium and low projected impact of HIV/AIDS on the human development index without a zero origin



Projected high, medium and low human development index values

YEAR	HIGH IMPACT (NOT=38.8%)	MEDIUM IMPACT (NOT=48.8%)	LOW IMPACT (NOT=58.8%)
1985	0.446	0.446	0.446
1986	0.459	0.459	0.459
1987	0.476	0.476	0.476
1988	0.491	0.491	0.491
1989	0.504	0.504	0.504
1990	0.518	0.518	0.518
1991	0.532	0.532	0.532
1992	0.546	0.546	0.546
1993	0.560	0.560	0.561
1994	0.572	0.572	0.573
1995	0.583	0.584	0.585
1996	0.585	0.587	0.589
1997	0.579	0.581	0.584
1998	0.571	0.574	0.578
1999	0.565	0.570	0.575
2000	0.555	0.561	0.568
2001	0.553	0.561	0.569
2002	0.546	0.556	0.566
2003	0.541	0.551	0.563
2004	0.538	0.549	0.562
2005	0.538	0.550	0.564
2006	0.540	0.553	0.567
2007	0.544	0.557	0.572
2008	0.549	0.563	0.578
2009	0.554	0.568	0.584
2010	0.557	0.572	0.588
2011	0.560	0.575	0.592
2012	0.564	0.579	0.596
2013	0.568	0.584	0.601
2014	0.572	0.588	0.605
2015	0.576	0.593	0.610
2016	0.580	0.597	0.614

2017	0.580	0.597	0.615
2018	0.581	0.598	0.616
2019	0.582	0.599	0.617
2020	0.582	0.600	0.619
2021	0.583	0.601	0.620

Appendix II: Formulas used in computing HDI values from 1985 to 2021.

$$\text{Longevity} = \frac{\text{Actual life expectancy at birth value - 25 years}}{\text{85 years - 25 years}}$$

$$\text{Standard of living} = \frac{\text{Actual GDP per capita (PPP\$) - US\$100}}{\text{US\$40 000 - US\$100}}$$

Educational attainment = 2/3*Adult literacy + 1/3*Combined gross primary, secondary and tertiary enrolment ratio

$$\text{Adult Literacy} = \frac{\text{Actual adult literacy value - 0\%}}{\text{100\% - 0\%}}$$

$$\text{Combined gross enrolment ratio} = \frac{\text{Actual combined gross enrolment (\%) - 0\%}}{\text{100\% - 0\%}}$$

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