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The Impact of the HIV/AIDS Epidemic on Orphanhood Probabilities and Kinship Structure in Zimbabwe

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The Impact of the HIV/AIDS Epidemic on Orphanhood Probabilities and Kinship Structure in Zimbabwe

by

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Professor Kenneth W Wachter, Chair
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Abstract

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This dissertation addresses the problem of estimating and projecting orphanhood prevalence and kinship resources available to orphans in Zimbabwe, one of the countries hit the hardest by the HIV/AIDS epidemic. The extended family has been recognized as a major safety net against the negative consequences of the generalized HIV/AIDS epidemic in sub-Saharan Africa. However, little is known about the effect of the epidemic on the quantity of kinship resources available to children. This study contributes to the existing literature by providing a quantitative assessment of the material basis of traditional kin relations in Zimbabwe.

An approach based on formal demographic methods is used to evaluate the effect of the HIV/AIDS epidemic on maternal orphanhood, for the period 1980-2050. The model, which is informed by United Nations estimates and projections of demographic rates, provides insights on the process of orphans' generation. One of the main results is that the number of maternal orphans in the age group 0-17 years is expected not to decline until around 2030. This is related to the fact that the transition to orphanhood is a cumulative process with age, and that there is a lag between the peak in adult HIV prevalence and the one in AIDS-related orphanhood prevalence.

A microsimulation model, whose core relies on SOCSIM, is used to estimate quantities for which analytical expressions are unmanageable, such as kinship resources for double orphans. The model is calibrated to the Zimbabwean setting, using data from the Demographic and Health Surveys (DHS) and estimates and projections from the United Nations. The results of the simulation show a transition, between 1990 and 2010, from fairly high to fairly low levels of kinship resources for young children in Zimbabwe. The proportion of double orphans without any living grandparents will increase until about 2030 and then will decrease. This trend will shift the responsibility for double orphans to uncles and aunts. On average, the number of uncles and aunts per double orphan has been decreasing from 1980 to 2010, but it is expected to increase progressively during the next decades.

Methodologically, the dissertation deals with the problem of calibration and statistical inference for stochastic demographic microsimulations. Traditional forms of parameter tuning are formalized within a Bayesian framework. The approach does not provide a definite answer to the problem of statistical inference for the outputs of demographic microsimulations. However, it

provides a first contribution towards the development of a more comprehensive methodology to assess uncertainty in the field of stochastic kinship forecasting.

The dissertation provides a quantitative basis for the study of the stress imposed by the HIV/AIDS epidemic on traditional forms of kin relations. This research raises questions on the social consequences of changes in kinship structure, and on the strategies needed to address the lack of care in the context of a generalized HIV/AIDS epidemic.

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Acknowledgments

There is a common belief that the dissertation is a solitary endeavor. This perception fundamentally downplays the extremely important role of mentors, colleagues, family, friends and the community at large. Without their teaching, constructive criticism, support and encouragement, this study would not have been possible.

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Chapter 1

Introduction

The HIV/AIDS epidemic has led to an unprecedented mortality crisis in the population of sub-Saharan Africa. Individuals infected with the HIV virus suffer from the direct consequences of the disease. The impact of the epidemic, however, is not limited to the people who contract the disease. The psycho-physical, emotional and economic consequences of the epidemic are felt by family members, as well as members of the extended family, and the community at large (e.g., Palloni and Lee 1992; Bor and Elford 1998; Wachter et al. 2002).

Although there has been some progress in the containment of the epidemic worldwide, HIV/AIDS remains a pressing problem, especially in sub-Saharan Africa. According to UNICEF figures, in 2008 in the region of sub-Saharan Africa 22.4 million people were living with HIV, 1.9 million were newly infected with HIV, and 1.4 million died due to AIDS. The HIV/AIDS epidemic has generated a very severe orphanhood problem. UNICEF (2006) estimated that in 2005 there were about 48 million orphans (at least one parent dead) in the age group 0-17 years, across sub-Saharan Africa. That corresponds to about 12% of all children 0-17 years old in the region.

Even under the optimistic scenario of a fairly rapid reduction in new HIV cases over the next decade, the number of orphans will continue to grow. This is a consequence of the fact that the transition to the orphanhood state is a cumulative process with age, and that there is a lag between the peak in adult HIV prevalence and the one in AIDS-related orphanhood prevalence.

The negative indirect consequences of the HIV/AIDS epidemic are likely to become harsher and harsher on children and the elderly. Traditionally, in the setting of sub-Saharan Africa, child fosterage, and other social practices based on mutual support and reciprocal obligations among members of the same kin, have mitigated the impact of orphanhood. The extended family has been recognized as a very important safety net. However, it has also been noted that with the rising levels of widowhood and orphanhood, associated to the HIV/AIDS epidemic, the material basis of traditional kin relations may weaken to a point such that new forms of social relations may emerge (e.g., Palloni and Lee 1992; Merli and Palloni 2006).

How much pressure will be exerted on traditional forms of care and support? How many orphans will be there? How much kinship resources will be available to children? How heavy will the burden on traditional caregivers be? This dissertation addresses these and related questions. Estimates and projections of orphanhood prevalence and kinship resources available to orphans are important to evaluate alternative strategies, and the resources needed, to address the lack of care. They are also relevant for the debate on whether new forms of social relations may replace traditional ones based on kin relations.

I use formal demographic methods and microsimulation to estimate and project probabilities of orphanhood and the evolution of kinship structure in Zimbabwe. The study is the first attempt to evaluate, in a quantitative and systematic way, overall kinship resources available to orphans in the context of sub-Saharan Africa. The geographical focus is Zimbabwe, one of the countries hit the hardest by the HIV/AIDS epidemic. On a background of poverty, economic crisis and international political isolation, the current adult HIV prevalence rate is estimated to be between 15% and 20% in Zimbabwe. After reaching a peak of almost 30% at the end of the 1990s, the adult HIV prevalence rate has been decreasing, but it is still extremely high. According to estimates produced by UNICEF (2006), 21% of children 0-17 years old in Zimbabwe were orphans in 2005. The orphanhood problem in Zimbabwe is likely to last for decades. A quantitative assessment of the extent of the crisis is vital to address adequately the lack of care.

Substantively, I present estimates and projections of orphanhood probabilities and kinship structure in Zimbabwe for the period 1980-2050. I show the erosion of kinship resources available to children and I discuss the potential consequences. Methodologically, first I propose an approach to evaluate trends in maternal orphanhood which is based on the formal demography of kinship. This method has low data requirements and it is potentially useful for comparative purposes. Then, I use a microsimulation model, whose core is SOCSIM, to evaluate the evolution of kinship structure over time. This model has higher data requirements, but it also provides a richer set of information. Finally, I formalize within a Bayesian framework the traditional process of parameters tuning for demographic stochastic microsimulations.

Chapter two provides some background on the impact of the HIV/AIDS epidemic on children in sub-Saharan Africa. It reviews the relevant literature on the effects of orphanhood on economic, education and health outcomes. The role of the extended family as a safety net, and traditional forms of social relations such as child fosterage, are discussed. Finally, the chapter gives some figures on number of orphans and prevalence of orphanhood in sub-Saharan Africa. The techniques used by major international agencies to estimate these numbers are summarized.

Chapter three gives some background information on the Zimbabwean setting and an overview of the available data sources. The main data collections that I describe and use in the chapter are the Zimbabwe Demographic and Health Surveys (1988, 1994, 1999 and 2005/2006), and United Nations estimates and projections (the 2006 Revision of the World Population Prospects and the World Fertility and Marriage Database 2003). In the second part of the chapter, I describe the methods that I use to indirectly extract specific sets of rates that inform the formal demographic model and the microsimulation. The appendix provides tables with estimates and projections of demographic rates for Zimbabwe (e.g., age and sex specific mortality, fertility and marriage rates). These quantities are obtained using data provided by the United Nations and the Demographic and Health Surveys.

Chapter four deals with the use of formal demographic analysis to obtain insights on the process of generation of orphans. The first part of the chapter deals with the application of results from the stable population theory to the context of a generalized HIV/AIDS epidemic. In the second part of the chapter, I extend the formal analysis of maternal orphanhood in two main directions. First, I consider the situation of demographic rates changing over time. Second, I analyze the effect of population heterogeneity on prevalence of maternal orphanhood.

Chapter five examines the effect of the HIV/AIDS epidemic on kinship resources available to orphans in Zimbabwe. An approach based on microsimulation complements the formal demographic analysis of chapter four. In the first part of the chapter, I describe the simulation model that I use. In particular, I emphasize the modifications to the original version of SOCSIM that have been made to model the effect of the HIV/AIDS epidemic on kinship structure. In the second part of the chapter, I present my results on maternal, paternal and grandpaternal resources for orphans. I then assess the average number of older siblings, uncles and aunts who may be available to alleviate the burden of orphanhood.

Chapter six focuses on the calibration of the microsimulation model and statistical inference for the quantities of interest. I discuss how the parameters tuning for SOCSIM has been done traditionally. Then I present some literature on statistical inference for simulation models. Finally, I propose a Bayesian approach to calibrate the microsimulation model. I also indicate directions in which the method that I suggest can be extended to make further progress in the assessment of uncertainty for outputs of stochastic demographic microsimulations.

Chapter seven summarizes the main results of the dissertation and critically discusses them. In this final chapter, I also present my research plan for the near future to expand and improve the work presented in this dissertation.

Chapter 2

Background on the impact of the HIV/AIDS epidemic on children in sub-Saharan Africa

"It wasn't supposed to be like this. These children's parents were supposed to be taking care of me. Now they are dead and I am nursing their children."[1]
-Akeyo, 74 years old,
looking after 10 grandchildren in Kenya

2.1 Introduction

The impact of the HIV/AIDS epidemic extends beyond infected individuals. The devastating consequences of the disease are felt by relatives and members of the community (e.g., Palloni and Lee 1992; Bor and Elford 1998; Wachter et al. 2002). Children are particularly vulnerable to the epidemic and are at great risk physically, emotionally and economically. They are affected by the epidemic both indirectly and directly (e.g., Foster and Williamson 2000). Children are affected indirectly when their communities are strained by the consequences of the HIV/AIDS epidemic. The services provided by the communities may be reduced both quantitatively and qualitatively with the onset of the epidemic. Doctors, nurses and teachers may suffer from the disease and this may have adverse consequences on the level of education and health care provided to children.

Children are directly affected by the HIV/AIDS epidemic in several different ways. Before the death of a parent, they may live with ill people and be requested to work and postpone their education in order to take care of the household. They may experience economic strain in the family and they may be subject to discrimination and stigma. Children can also become orphans and need care from the extended family.

In this chapter, first I will review the consequences of the HIV/AIDS epidemic on children in sub-Saharan Africa, the region of the world that has been hit the hardest by the HIV/AIDS epidemic. I will then discuss the coping mechanisms in place, the role of the extended family and the strain imposed on traditional safety nets. Finally, I will show the methodologies that have been used in the literature to quantify the impact of the HIV/AIDS epidemic on the generation of orphans, that is people who have lost at least one parent, a specific member of the kinship group. I will also provide some estimates of the extent of the orphanhood crisis in sub-Saharan Africa.

2.2 Impact of HIV/AIDS on children in sub-Saharan Africa

The HIV/AIDS epidemic has a pervasive negative effect on multiple spheres of children's lives. Children may be affected only indirectly, at a community level, or they may experience the burden of the disease directly in their households. Children may have to drop out of school to help with household work or to care for ill parents, and may suffer both psycho-social distress and material hardship following the death of a parent.

The degree to which children are affected by the HIV/AIDS epidemic depends on several interrelated factors. For instance, some important elements that may mitigate or worsen the impact

[1]Source: HelpAge International and International HIV/AIDS Alliance, *Forgotten Families: Older People as Carers of Orphans and Vulnerable Children*, HelpAge International / International AIDS Alliance, Brighton, 2003. As it appears in UNICEF (2006).

of the disease are the overall level of incidence of the epidemic, the economic situation of the community and the households affected by the disease, the gender of the children and their age when a household member gets infected, the efficiency of safety nets, etc.

In this section, I review studies on the impact of the HIV/AIDS epidemic on children. I will discuss the economic impact of the epidemic, as well as the effects of the epidemic on children's education and health.

2.2.1 Economic impact

Children start feeling material hardship before they become orphans. When a parent develops HIV-related symptoms, children may have to take care of the household and the ill parents or young siblings. They may have to dedicate their time to activities such as cooking, cleaning, carrying water, care giving, etc.

The division of workload among children is gender-specific. Girls are more frequently care-giving providers for female relatives and take more responsibilities for domestic work (Robson 2000). Boys are more involved in agricultural and income generating activities that help with medical expenses and compensate the reduced amount of work of the parents.

When children become orphans, their workload may increase, either because their household has been impoverished by the death of a parent (e.g. due to the loss of a parent's income and the high costs of a funeral), or because the orphans move to the household of a relative, where their workload may be greater than the one of non-orphans living in the same household (Foster et al. 1997).

Children may risk to lose the properties of their family. For instance, in the case of Zimbabwe, only a very small proportion of families write a will prior to death (Drew et al. 1996). In some cases, properties are inherited by paternal relatives and there may be instances of "property-grabbing". The extent of these practices varies from region to region. The results of a survey study in Zimbabwe show that property is usually inherited by children, with 15% of respondents reporting "property-grabbing" (Drew et al. 1996).

The poorer people in a community, especially women, are the ones that usually take care of orphaned children in sub-Saharan Africa (Foster and Williamson 2000). This is related to the fact that orphans tend to live more frequently in larger households with a less favorable dependency ratio and where the caregiver is much older than the child (Monasch and Boerna 2004).

Better-off families, on the other hand, tend to find their economic reserves depleted since they are continuosly asked to provide economic resources to relatives affected by AIDS (Foster and Williamson 2000). Beegle et al. (2010) use longitudinal data for a region of northwestern Tanzania to show that, in terms of consumption expenditure, there is a gap of 8.5% between maternal orphans and children whose mother survived until at least their 15th birthday.

2.2.2 Impact on education

When a parent becomes sick, his/her children's education is often disrupted. With the financial strain of the disease and the reduced resources available for the household, there may not be enough funds for children to go to school, or the children's caregivers may have less interest in the children's welfare. Thus children might have to do either domestic work or income generating activities and miss opportunities in education in terms of lack of enrollment, interrupted schooling and poor performance while in school (UNICEF 2006).

Although there are significant variations across countries, several studies provide evidence that the enrollment rate for orphans is significantly lower than the one for non-orphans. For instance, a study based on data from eastern Africa shows that double orphans in the age group 6-10 are half as likely to be at the correct educational level, compared to non-orphan children of the same age (Bicego et al. 2003).

In some circumstances, young girls may be more at risk of being denied education than boys. However, it is not clear whether the gender gap is more prominent in orphans than in non-orphans (UNICEF 2006). In certain studies, probabilities of enrollment appear to be negatively correlated with certain characteristics of the children, such as being a girl orphan, an AIDS-related orphan, living in a rural or poor household or in a household headed by a man (World Bank 1997; Foster and Williamson 2000).

One important factor in the determination of educational outcomes for orphans is the relationship between the child and the head of household. The closer the biological tie, the more likely the child is to go to school consistently, independently of the poverty level. As a matter of fact, the closest relatives tend to make substantial commitments to ensure that their children attend school (UNICEF 2006).

2.2.3 Impact on health

The HIV/AIDS epidemic has had a strong impact on children's mortality. For the youngest age group (ages 0-3 years), the loss of a parent is significantly associated with the probability of survival. Zaba et al. (2005) estimate, from cohort studies in Uganda, Tanzania and Malawi, that the excess risk of mortality for children with an HIV-positive mother is 2.9 and lasts throughout childhood. The excess risk of mortality associated to maternal death is 3.9 in the 2-year period centered around the mother's death.

Children who become orphans are more vulnerable than non-orphans. Some of them become street children or prostitutes and are more likely to get infected with HIV (Richter and Swart-Kruger 1995).

Although there is little evidence of a general increase of morbidity and mortality in orphans, it is expected that the health of orphans, particularly those in the care of adolescents and elderly caregivers, is worse than the one of other children (Foster 1998). Orphans may be more malnourished than non-orphans, possibly because of reduced household resources or because parental illness or death interfere with child rearing. This may affect the incidence of morbidity in orphans.

Orphanhood has important consequences on psychological health, in addition to physical health. The stress and trauma of parental illness and death is amplified by stigmatization, dropping out of school, changes in friendships, increased workload, discrimination and social isolation (Foster and Williamson 2000). Sengendo and Nambi (1997) conducted a study on children in Uganda and found that most orphans were depressed, with lower expectations about the future than non-orphans. They observed that orphans that relocated from urban areas to rural areas were more depressed, implying that the failure to adapt to social change leads to psychological problems. They also noticed that depression was more likely in children living with a widowed father than in those living with a widowed mother, suggesting that the loss of the mother is more distressing than the loss of the father.

Both children and adults feel grief for the death of their parents. But children, unlike adults, may not immediately understand the finality of death and thus may not go through the grieving process that is fundamental to recover from the loss (Brodzinsky et al. 1986). Children may not have reached a stage of intellectual and emotional development that enable them to positively control negative emotions. They are more at risk of growing up with unresolved negative emotions which are often expressed with anger and depression. The support and encouragement from adults to express emotions are crucial to the psychological health of the orphans. This support may not be present in the context of a generalized HIV/AIDS epidemic, where basic material needs may not be met.

Children's behavior changes during parental illness. They often become sad, worried and stop playing to be near the parents. They are more likely to become solitary, to appear miserable, distressed, fearful of new situations and to develop low self-esteem (Foster and Williamson 2000).

AIDS-related orphans who lack social, economic and psychological support tend to become more vulnerable to HIV infection through early onset of sexual activity, commercial sex and sexual abuse. The lack of support therefore affects the future physical health of children also indirectly.

2.3 Coping mechanisms and the extended family

To a first approximation, a generalized HIV/AIDS epidemic strongly affects mortality and fertility rates, with important consequences on population age structure, sex ratio and probability of orphanhood. To a second degree of approximation, the epidemic affects household structure, movements in and out of the household, and the availability of kinship resources, both for young children and for the elderly (e.g. Wachter et al. 2002, 2003; Heuveline 2004).

In the sub-Saharan setting, the extended family is the predominant caring unit for orphans in communities that are severely affected by the HIV/AIDS epidemic (Ankrah 1993). The main mechanism that prevents families from falling into destitution operates through community members and the extended family, who provide material relief and economic support.

In this section, I discuss the coping mechanisms that are in place in the context of sub-Saharan Africa to deal with the orphanhood crisis. The most important safety net is provided by the extended family. Some nurturing roles are delegated to non-biological parents, through fostering practices. Social protection provided by governments is very limited or inexistent in most settings. When some forms of social protection are in place, indirect assistance to foster families or parents whose partner had died, may benefit only a small proportion of the population, namely members of the middle-class who are employed in the formal sector. Typically, especially for poor people, work is home-based and in the informal sector, without particular protections from the government. In a crisis situation, external help may come from religious organizations or NGOs, often funded by international organizations. More often, the primary source of assistance comes from the extended family.

A major issue is whether traditional fostering practices can adapt to the increasing stress imposed on them by the HIV/AIDS epidemic. It is important to identify who the care takers for orphans are and to what extent kinship members are involved in rearing orphans. I will discuss how the kinship role may change with the onset of the HIV/AIDS epidemic and I will conclude by pointing out the importance of a quantitative evaluation of the kinship resources available to orphans.

Who takes care of orphans? The question is of central importance. Providing an answer to it requires some discussion of fostering practices in sub-Saharan Africa. The coping mechanisms regarding orphans in sub-Saharan Africa are complex and vary across countries and social settings. However, a common element that distinguishes sub-Saharan Africa from western societies is that children are fostered, rather than 'adopted'. Child fostering consists of a culturally sanctioned arrangement such that children are reared by adults other than the biological parents. These arrangements are agreed upon by biological parents and other adults, often relatives. They contribute to strengthen ties across the community and they provide mutual benefits for both natal and fostering families. Although institutional care exists, mostly in post-conflict countries, generally orphanages are not culturally and socially acceptable, in addition to being extremely expensive.

Fostering practices in sub-Saharan Africa can be categorized into two different classes: 'purposive' and 'crisis' fostering. There are several reasons to foster a child under voluntary circumstances. Isiugo-Abanihe (1985) reviews the motivations for purposive child fostering in West Africa. Most fostering in West Africa takes place within the kinship network and it is largely motivated by the need to reallocate resources within the extended family or clan, in order to maximize the survival probabilities of the kinship unit and to strengthen kinship ties. Altogether, fostering practices are strongly related to reasons such as kinship obligations, apprenticeship/training, alliance building, domestic labour and education. Purposive fostering relies on reciprocal advantages, responsibilities and rights. There are a set of social rules that determine the age structure of the exchange, which is intended to be symmetrical. Crisis fostering, on the other hand, involves some specific obligations. Esther Goody, in her classical book about fostering roles in West Africa, pointed out that kin members who have the right to the child in voluntary fostering are also obligated to foster the child in a period of crisis.

Orphanhood is not a new problem in sub-Saharan Africa, a region where mortality rates have been relatively high since before the onset of the HIV/AIDS epidemic. In the past, the combination of fostering practices, the obligation of relatives to take care of orphans, and the ralative abundance of kinship resources alleviated the problem (e.g., Ntozi and Nakayiwa 1999). In addition to kinship obligations, the choice of the foster parent also depends on the reasons for fostering. If the objective is labour or simple companionship, grandmothers and childless couples tend to be an obvious destination (Goody 1982; Isiugo-Abanihe 1985).

With the increasing prevalence of HIV, how do foster practices for orphans change? First, with the onset of the HIV/AIDS epidemic, not only the overall number of orphans increases, but also the proportion of them who are double orphans increases, because of HIV transmission that occurs within couples. The increased number of double orphans, coupled with the higher mortality rate of adults, reduces the number of adult kin and increases the burden on grandparents. This situation raises questions on whether the logic of fostering, that enabled a sustainable distribution of obligations among kin in the past, may be overwhelmed by the rapid increase in AIDS-related deaths (Madhavan 2004).

Drew et al. (1998) observe that, although traditionally in Zimbabwe orphans have been incorporated into the extended family, the very high number of adult deaths has shifted the burden to elderly and adolescents. As a result, the phenomenon of grandparent-headed households and adolescent-headed households has been increasing. In the traditional Zimbabwean society, orphan children were cared for by members of the extended family. Geoff Foster (2000), in particular, describes how the caregiving functions of parents were usually taken on by paternal aunts and uncles. More recently, the safety net provided by the extended family has been weakened. According to Foster (2000), there are several reasons behind this process, such as changes in the economy, labor migration and formal education. Another important reason is the reduction of the number of available aunts and uncles, due to the HIV/AIDS epidemic, during a time when orphans have been increasing. With the increasing number of orphaned children and the unavailability of traditional caregivers, grandparents are recruited into childcare (e.g. Foster et al. 1996). Grandparents are often a last resort and agree to take orphans because other relatives are not available or refuse, generating, in some cases, situations of mutual support, where frail grandparents become recipients of care from grandchildren (Foster 2000).

Foster (2000) suggested measuring the strength of the extended family safety net by monitoring certain proxies. In particular, we may expect that where traditional values are maintained, such as in rural communities, the extended family safety net is better preserved. Analogously, the prevalence of purposive fostering within a community is an indicator of the strength of the extended family safety net. Where traditional widow inheritance is common, then orphan inheritance is likely to be prevalent too. The higher the frequency of regular contacts between relatives, the smaller the risk for orphans to be abandoned. Conversely, such risk is higher in situations where unions are established without the payment of a brideprice.

The role played by members of the extended family in providing care for orphans is strongly related to cultural practices that vary across time and geographical regions. The onset of the HIV/AIDS epidemic has influenced such practices through changes in behavior, for instance in terms of stigmatization of households affected by HIV/AIDS. The epidemic has also dramatically altered the demographic structure of the population, reducing the amount of kinship resources available to orphans and to the elderly. There have been several anthropological studies about the effect of the epidemic on the role of the extended family as a safety net in sub-Saharan Africa. Most of the quantitative research in this area has focused on a very specific set of kin members, that is 'parents'. There has not been a comprehensive quantitative evaluation of the effect of the epidemic on kinship structure in sub-Saharan Africa. In the next section, I will review relevant quantitative studies on estimation of orphan numbers and orphanhood probabilities. In the next chapters, I will develop on some of the concepts related to the estimation of orphanhood probabilities in order to quantitatively evaluate the effect of the HIV/AIDS epidemic on kinship resources available to children and the elderly.

2.4 Estimation and prediction of the number of AIDS-related orphans

In order to adequately address the orphanhood problem in sub-Saharan Africa, a statistically sound approach to estimate the extent of the crisis is necessary.

In this section, I review the main methodologies that have been proposed in the literature to estimate and predict the number of orphans and the probability of being orphaned at a specific age. I then provide some estimates of these key quantities. The review focuses on methods and estimates for the geographical setting of sub-Saharan Africa, in the context of the generalized HIV/AIDS epidemic.

Before going into the details of the methodologies, I would like to clarify the terminology that I will use. An orphan is a child (in the age range 0-15 years, unless otherwise specified) who has at least one biological parent dead. An AIDS-related orphan is a child who has at least one parent dead as a result of AIDS. A maternal (paternal) orphan is a child whose mother (father) has died. If the mother (father) has died of a cause associated with AIDS, then I refer to the child as AIDS-related maternal (paternal) orphan. A double orphan is a child whose parents have both died. A double AIDS-related orphan is a child whose parents have both died, at least one of them as a result of AIDS.

2.4.1 Survey estimation

The first and probably most obvious way to estimate the number of orphans is to 'count' them. For several countries, censuses are available and the number of orphans can be computed from census data. In some circumstances, census data may not have been collected, or they may not be reliable. In those situations sample surveys are a useful tool to estimate the number of orphans.

For a large set of developing countries and, in particular, for sub-Saharan countries, nationally representative household surveys that provide information on orphans are available. The most relevant surveys are part of the Demographic and Health Survey (DHS) program, sponsored by USAID. These surveys collect information on household members and they ask questions on survivorship of the mother and the father of the child. For instance, questions like "Is this child's mother alive?" and "Is this child's father alive?" for every child aged 0 to 14 years are included in the surveys. This is a primary source of information on orphanhood from which direct estimates of number and prevalence of orphans can be obtained. These estimates can also be disaggregated by geographical area and by socio-economic characteristics of the household.

A second relevant source of information that comes from DHS surveys is given by the sibling history portion of the individual women's and men's interviews. Information about fertility and mortality of the siblings of the respondent is collected. In particular, we know the age at death for the sister and the number of children she gave birth to during her life. With these data it is possible to indirectly estimate the number of maternal orphans.

The main concern with results directly obtained from surveys is the reliability of the estimates. In a context where there are possibilities of financial help for households that take care of orphans, it is possible to have overreporting problems. Conversely, in certain cultural settings, an orphan who moves into the household of a relative may not be considered an orphan anymore by the householder, thus leading to a problem of underreporting.

2.4.2 Methods based on demographic and epidemiological modeling

The HIV/AIDS epidemic affects the number of orphans mainly through increased mortality of children and adults, and reduced fertility of HIV-positive women.

Different methodologies, based on different sets of assumptions, can be used to estimate the number of AIDS-related orphans. For instance, Gregson et al. (1994) evaluate the potential impact of the HIV/AIDS epidemic on orphanhood in sub-Saharan Africa using a mathematical model that combines demographic, biological and behavioral parameters. Jones (2005) uses mathematical demography of kinship to evaluate the impact of the generalized HIV/AIDS epidemic in sub-Saharan Africa on maternal orphanhood probabilities.

Estimates of orphanhood probabilities have been produced by International Organizations with different methods. Recently, there has been some interest in harmonizing the methods across agencies that produce estimates of number of orphans. Here I present the methods that have been used by the US Census Bureau to produce estimates of the number of orphans related to AIDS causes and other causes of death. These methods have been adopted by the Joint United Nations Program on HIV/AIDS (UNAIDS), United Nations Children's Fund (UNICEF) and US Agency for International Development (USAID) since 2002. The methodology is spelled out in Grassly et al. (2005).

The number of AIDS-related maternal orphans at age a is a quantity that depends on several demographic and economic factors. The HIV/AIDS epidemic affects the intensity of mortality rates for both children and adults. The stage s of HIV infection of the mother, when she gives birth, affects the probability of vertical transmission of the infection to the child (ξ_s). The probability of survival to age a for a child whose mother was in the stage s of HIV at childbearing is:

$$\xi_s l'_a + (1 - \xi_s) l_a$$

where l'_a and l_a are the survival probabilities to age a for an infected and an uninfected child, respectively.

If we know the proportion of women who were in the stage s of HIV when they gave birth and they die before their child reach age a, then we can compute the probability that a child survives to age a given that his or her mother died of an AIDS-related cause τ years ago:

$$\sum_{s=0}^{n} [Y_s(a - \tau)(\xi_s l'_a + (1 - \xi_s) l_a)]$$

where $Y_s(a-\tau)$ represents the proportion of adults who died of AIDS-related causes τ years before the reference date for the present and that were in stage s of the of HIV infection $(a - \tau)$ years before death, that is at the time of child's birth. The quantity n is the number of stages of HIV infection considered.

Two other important quantities enter into the calculation of the number of maternal orphans. First, the fertility history of a woman determines the probability that a woman who died of AIDS had a child at a particular age and time. Second, the number of women who died of AIDS-related causes at a specific time. By putting together this information with the previous elaborations and by summing up over age and stages of infection, Grassly et al. (2005) show that the number of maternal AIDS-related orphans of age a at time t, whose mother died τ years ago, can be expressed as:

$$\Omega'_{t,a,\tau} = \sum_{i=15}^{49} \{\mu'_{t-\tau,i+a-\tau} \sum_{s=0}^{n} [m_{i,s,t-a} Y_s(a-\tau)(\xi_s l'_a + (1-\xi_s) l_a)]\} \tag{2.1}$$

where $\mu'_{t-\tau,i+a-\tau}$ is the number of women of age $i+a-\tau$ who died of AIDS-related causes at time $t-\tau$. $m_{i,s,t-a}$ is the fertility rate of women of age i in HIV stage s at time $t-a$.

The number of AIDS-related paternal orphans can be estimated using an approach analogous to the one described for calculating the number of AIDS-related maternal orphans, given that data on age-specific fertility profiles of men are available. The major difficulty in evaluating paternal orphanhood is that estimates of concordance of HIV status of the mother and the father are required in order to determine correct probabilities of vertical transmission and the survivorship of fathers.

Several factors influence the concordance of HIV status of partners. Transmission between partners depends on a series of factors such as the length of the partnership, the stage of the man's HIV infection, the number and types of sexual acts and the prevalence of cofactors that enhance the transmission of HIV (Grassly et al. 2005). The prevalence of HIV among all women is also indicative of how likely it is for a woman to become infected in a different partnership and the level of risk associated to HIV-positive men who select high-risk women. Since for most countries there is not much data on all these quantities, Grassly et al. (2005) estimated the concordance of HIV status between partners using a logistic regression model of prevalence of HIV among the female partners of HIV-positive men against prevalence in the general population, as measured at antenatal clinics (ANCs) in selected countries in sub-Saharan Africa. Their regression equation relates the probability that a woman is HIV-positive, given that her partner is positive, to HIV prevalence measured at ANCs. They found that, when the epidemic is not generalized in the population, about 30% of women with a positive partner are predicted to be positive themselves as a result of transmission within the partnership. When the prevalence in the general population rises, then the fraction of HIV-positive women with an HIV-positive partner linearly increases, mainly due to the increased risk of preexisting infection. The prevalence of HIV infection among women with uninfected partners is significantly lower than in the general female population.

The prevalence of maternal and paternal orphanhood is strongly affected by the HIV-AIDS epidemic, through its consequences on mortality and concordance of HIV status between partners. The correlation in HIV status between partners has a relevant effect on the prevalence of double orphanhood. If the risk of dying of a child's mother and father were independent, the expected proportion of double orphans among children of age a would be the product of the proportion of children of age a who lost their mother and the proportion of children of the same age who lost their father. Due to the concordance of HIV status between partners, the probability of being a double orphan is higher than the one expected assuming that the deaths of parents are independent. Grassly et al. (2005) used data from Demographic and Health Surveys conducted in 25 countries to predict double orphanhood as the product of its expected prevalence, under the assumption of independent mortality of parents, and the observed excess risk of double orphanhood relative to its expected risk. They estimated that, for the countries that they considered, the risk of being double orphan for children aged 0 to 14 years is between 2 and 5.7 times the expected risk that would be obtained assuming that the mortality of mother and father were independent.

2.4.3 Estimates

In this subsection, I provide a quantitative picture of the extent of the orphanhood crisis in sub-Saharan Africa. The data presentation is based on estimates released by international agencies, such as UNICEF and UNAIDS, and obtained using the methods described in the previous section. I focus on southern Africa, which is the region where the extent of the crisis is the largest.

According to UNICEF (2006), at the end of 2005, about 25 million people in sub-Saharan Africa were living with HIV, representing two thirds of the world's population infected with HIV. It is estimated that 2 million of these people were children under age 15.

In 2005, sub-Saharan Africa was home to over 48 million orphans younger than 18 years old. 12 million of them were AIDS-related orphans and about 9 million were double orphans. In other regions of the world, the total number of orphans has been declining over time. Conversely, in sub-Saharan Africa the total number of orphans has been increasing. In 1990, about 31 million orphans were estimated to be in the region, 1% of them orphaned by AIDS. It is expected that in 2010 there will be over 53 million orphans in the region, 30% of them orphaned by AIDS (UNICEF 2006).

Table 2.1: Estimated summary statistics for orphans in southern African countries, 2005, released by UNICEF (2006).

Country	Total number of orphans	% of children who are orphans	Children orphaned by AIDS as % of all orphans	% of children aged 0-5 who are orphans	% of children aged 6-11 who are orphans	% of children aged 12-17 who are orphans
Angola	1,200,000	14	13	6	16	24
Botswana	150,000	19	76	8	22	27
Lesotho	150,000	17	64	8	20	25
Malawi	950,000	15	57	6	17	24
Mauritius	23,000	6	-	2	6	11
Mozambique	1,500,000	15	34	7	16	24
Namibia	140,000	14	62	6	15	19
South Africa	2,500,000	13	49	6	14	19
Swaziland	95,000	17	66	9	20	24
Zambia	1,200,000	20	57	9	23	30
Zimbabwe	1,400,000	21	77	9	24	30

Children are suffering the greatest parental loss in southern Africa, where the HIV prevalence rates are the highest, and where in most countries 15% or more of all children are orphans. Table 2.1 gives estimated summary statistics for orphans in southern African countries for 2005 (UNICEF 2006). It is striking to observe that in countries like Botswana and Zimbabwe the HIV/AIDS epidemic is responsible for the generation of more than 75% of the orphans in the age range 0-17. The highest proportions of children who are orphans in 2005 are obseved in Botswana, Zambia and Zimbabwe, where the values are around 20%. We can also notice a steep increase by age in the proportion of orphans. For instance, in Zimbabwe in 2005, 9% of children aged 0-5 are estimated to be orphans. This percentage quickly rises to 30% for children aged 12-17.

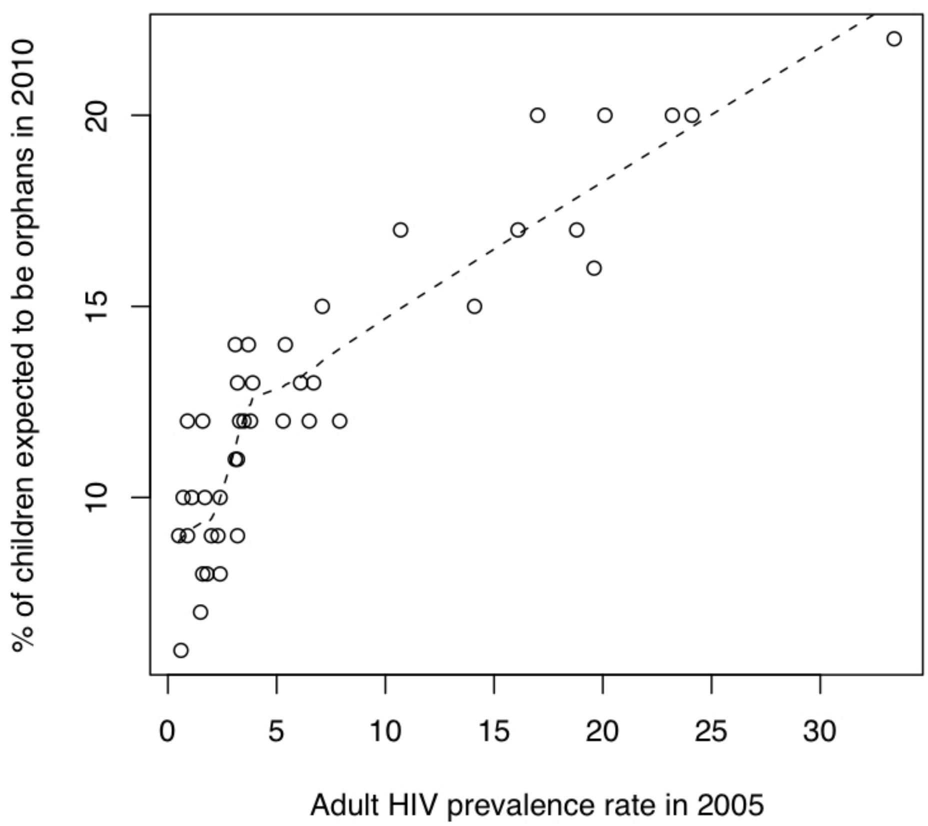

Figure 2.1: Relationship between predicted percentage of children expected to be orphans in 2010 and adult HIV prevalence in 2005 for sub-Saharan countries. Dots are observations, whereas the dashed line represents an interpolation obtained with a nonparametric smoother. Data source: UNICEF (2006).

Figure 2.1 shows the relationship between predicted percentage of children expected to be orphans in 2010 and adult HIV prevalence in 2005, for sub-Saharan countries. The dashed line is obtained using Friedman's 'super smoother' (Friedman 1984). It is interesting to observe how well the adult HIV prevalence rate at a particular time is predictive of the percentage of orphans in the country five years later.

2.5 Conclusions

This chapter sets the foundations for the analysis that I will develop later on. First, I provided some qualitative background information on the effect of the HIV/AIDS epidemic on children in sub-Sarahan Africa. I discussed the coping mechanisms that are in place in the African context and the role played by the extended family in caregiving practices for orphans.

Second, I dealt with the quantitative evaluation of the extent of the orphanhood crisis in sub-Saharan Africa. I provided a description of the main ideas behind the methodologies that have been adopted by international agencies to estimate the number of orphans. I then showed estimates of relevant quantities for countries in southern Africa, the region of the world hit the hardest by the HIV/AIDS epidemic.

In addition to providing background information on social arrangements in sub-Saharan Africa and the extent of the orphanhood crisis, the chapter raises some important questions that will be addressed later on. I identify the lack in the literature of a quantitative evaluation of the effect of the HIV/AIDS epidemic on kinship structure in the sub-Saharan context. This evaluation is necessary to assess the available kinship resources for orphans and the elderly. A quantitative assessment of the effect of the HIV/AIDS epidemic on kinship resources for the elderly has been developed in the context of south-east Asia (Wachter et al. 2002, 2003), but there has not been a similar attempt for the geographical region of sub-Saharan Africa. A quantitative analysis of kinship resources for elderly and orphans would contribute to the debate on the extent to which the safety net provided by the extended family is under stress in the context of the HIV/AIDS crisis.

Methodologically, one way to analyze kinship resources is to use fairly general models that provide some intuition on the processes that regulate the formation of orphans and the availability of kin. Alternatively, more detailed parameterizations, tailored to a specific social and geographical context, can be pursued. In the next chapters, I will use tools developed in the field of mathematical demography and demographic microsimulation to address the problem of quantitatively evaluating kinship resources for orphans and the elderly in the context of the generalized HIV/AIDS epidemic in sub-Saharan Africa.

Chapter 3

Data for the Zimbabwean setting

3.1 Introduction

One of the greatest challenges for research in sub-Saharan Africa is the limited availability of reliable and comparable data sources. Even when data and estimates for key demographic quantities are available, it is often hard to assess their reliability and the uncertainty associated to them. The goal of this chapter is to provide some background information for the Zimbabwean setting and an overview of the data sources that I will use throughout the entire research project. I will describe the main data sources that are available for Zimbabwe and the methods that I use to indirectly extract specific sets of rates from available data.

For Zimbabwe, we have two main data sources that provide aggregate demographic rates to inform our models: United Nations (UN) population statistics and the Demographic and Health Surveys (DHS). The most relevant collection of demographic data from the United Nations is the *2006 Revision of the World Population Prospects.* These data come in the form of a CD-ROM which contains essential demographic data such as estimates and projections of total births, total deaths, population counts, mortality and fertility indicators by five-year age groups and sex for the period 1950-2050. A complementary data source from the United Nations Population Division is the World Fertility and Marriage Database 2003.

The Demographic and Health Survey provide rich sample surveys collected in Zimbabwe for the years 1988, 1994, 1999 and 2005/2006. The 2005/2006 DHS for Zimbabwe includes a module on HIV seroprevalence based on HIV testing administered to the respondents.

In this chapter, first I will give an introduction to the Zimbabwean setting. Then I will talk about data sources. Finally, I will show the strategies that I propose to indirectly estimate specific sets of rates that are not readily available and that I will need to carry out orphanhood-related calculations.

3.2 The Zimbabwean setting

Zimbabwe is a landlocked country in southern Africa that shares borders with Zambia, Mozambique, South Africa and Botswana (see figure 3.1). It covers an area which is slightly larger than Montana. It is mostly on a high plateau, with a higher central plateau and mountains in the eastern part of the country. The climate is tropical, moderated by the altitude. Recurring droughts are one of the main natural hazards.

The population size of Zimbabwe is between 11 and 12 millions, with a life expectancy of about 45 years, and a young population age structure: about half of the population is younger than 18 years. The total fertility rate (TFR) for 2009 is estimated to be about 3.7, and it is associated to a population growth rate of about 1.5% per year. Fertility rates are expected to continue decreasing, following a trend that started a few decades ago. In the early 1980s the TFR was around 6. According to UN estimates, it is expected to get closer and closer to replacement level in the next couple of decades.

Marriage is nearly universal in Zimbabwe. The proportion of never married women falls from about 76% in the age group 15-19 to 1% in the age group 45-49. Men tend to get married later in their life course than women. More than 99% of men in the age group 15-19 never married.

Figure 3.1: Map of Zimbabwe

The percentage of never married men becomes 75% for those in the age group 20-24 and about 1% for those in the age group 45-49 (see table A.39 in the appendix).

There are some relevant demographic differences between urban and rural population. The urban population accounts for slightly less than 40% of the total population. Urban areas are characterized by a less traditional approach to social relationship. Polygyny has a very low prevalence among young urban men and women. It is still fairly prevalent in rural areas. For instance, according to Demographic and Health Surveys data, the peak of polygyny prevalence is in the areas of Central Mashonaland, where about 8% of men have two or more wives. In Bulawayo, less than 1% of men have more than one wife. The prevalence of polygyny increases sharply with age. Part of the reason is that the formation of multiple wives or co-wives is a cumulative process that happens throughout the life course. However, there have also been major changes in attitudes towards polygyny, with younger cohorts less acceptant of polygyny, especially among more educated and wealthy women.

The two major ethnic groups in Zimbabwe are Shona (which accounts for about 82% of the population) and Ndebele (which accounts for about 14% of the population). For several centuries, until the 19th century, the area of contemporary Zimbabwe was ruled by a succession of Shona kingdoms. The system then collapsed due to internal and external pressure. In the 1830s, the Ndebele people settled in what is today's southern Zimbabwe, after migrating from south and generating upheaval in the region. In the 1880s, Cecil Rhodes' British South Africa Company took control of the area, that was then named 'Southern Rhodesia', until 1923, when it became a British colony. In 1965, the settlers issued a unilateral declaration of independence. This triggered a civil war between the white minority government and fighters for African independence, ending in 1980, with the granting of independence and the holding of a general election under British auspices, which was won decisively by Robert Mugabe's ZANU party.

Zimbabwe has benefited from a well developed infrastructure, health care and financial system. But the economy and the standards of living in the country have declined rapidly since the late 1990s. The involvement in the war in the Democratic Republic of Congo in 1998-2002 drained a large amount of resources from the economy. In 2000, President Mugabe started a land reform which entailed a compulsory land redistribution to blacks. One of the main consequences has been a sharp decline in agricultural production and export, which resulted in food shortages, high unemployment and capital flight from the country. All sectors of the economy have been severely affected. In order to fund the budget deficits, the Reserve Bank of Zimbabwe routinely printed money, leading to hyperinflation and, ultimately, to the suspension of the Zimbabwean dollar in 2009.

The HIV/AIDS epidemic contributed to an already dramatic situation of economic crisis and growing international isolation. Zimbabwe is one of the countries in the world hit the hardest by the HIV/AIDS epidemic. According to UNAIDS/WHO estimates (2008), the adult HIV prevalence rate reached a level of almost 30% towards the end of the 1990s. Since then, it has been decreasing to current levels of about 15-20%. The epidemic has had dramatic consequences on the country and has been challenging traditional forms of social relationships that are based on mutual support and reciprocal obligations among members of the same kin.

Traditionally, the extended family has had the role of a safety net. Zimbabwean Shona and Ndebele communities are built around a patrilineal kinship system. Members of the same patriline live together in multi-generational residential groups. In a traditional setting, people have a strong sense of belonging to a large extended family, help each other and share the resources. Marriage represents the symbolic union of two families and the payment of a brideprice transfers the responsibility for children to the father and his family. Traditionally, the concept of social orphan did not exist in Zimbabwe, since biological orphans could rely on the care of members of the extended family, and, in particular, on paternal aunts and uncles. With recent demographic and economic change, however, the extended family has been weakened. For instance, the fact that new members of the community, such as maternal, rather than paternal relatives, are becoming more prominent in providing care to orphans, especially in peri-urban areas, is an indication of the crisis of traditional extended family practices (Foster et al. 1995; Foster et al. 1997)

In this section, I provided an overview of the Zimbabwean setting which complements the more detailed discussion of the impact of the HIV/AIDS epidemic on children in sub-Saharan Africa and the role of the extended family, that I discussed in the previous chapter. In the next sections, I will present the data available to analyze the Zimbabwean context and the strategies that I used to obtain the relevant information that is needed to parameterize the formal demographic model and the microsimulation that will be discussed in the next chapters.

3.3 Demographic and Health Surveys

The Demographic and Health Surveys (DHS) are part of a project sponsored by the U.S. Agency for International Development (USAID) to provide data and analysis on the population, health, and nutrition of women and children in developing countries. The program started in 1984. Since then, DHS has provided technical assistance to 84 countries, for the implementation of more than 240 surveys, including HIV testing in more than 30 countries.

For Zimbabwe, surveys for four different time periods are available: 1988, 1994, 1999 and 2005/06. The Zimbabwe DHS are nationally representative surveys implemented by the Zimbabwean Central Statistical Office. The core of the surveys are household and individual questionnaires. The purpose of the household questionnaire is to collect information on characteristics of the household dwellings, to obtain basic data about the members of the household and the care and support available for them, and to identify members of the household who are eligible for an individual interview. Eligible respondents are then contacted and interviewed using an individual questionnaire that is different for women and men. Individual questionnaires include information on marriage, fertility, family planning, reproductive health, child health, and behavior towards HIV/AIDS. For special information, that are not contained in the core questionnaires, there are some optional questionnaire modules which are country-specific.

The first DHS in Zimbabwe was implemented in 1988. 4,789 households were selected and about 90% were successfully interviewed. At the individual level, only women were interviewed: among the eligible women, 4,201 were interviewed. The 1994 Zimbabwe DHS is a follow up to the 1988 DHS. It is a nationally representative survey of 6,128 women age 15-49 and 2,141 men age 15-54, implemented by the Central Statistical Office. The 1994 DHS, as the 1988 DHS, provides information on levels and trends in fertility, family planning knowledge and use, infant and child mortality, and maternal and child health. In addition to that, data have been collected on compliance with contraceptive pill use, knowledge and behaviors related to HIV/AIDS and other sexually transmitted diseases, and maternal mortality. The 1999 DHS for Zimbabwe is similar in scope to the 1994 DHS. The target sample was approximately 6,208 women and 2,970 men. The 2005-06 Zimbabwe DHS is the fourth of the series of DHS in Zimbabwe and the first one to collect information on malaria prevention and treatment, and domestic violence. It is also the first one to provide population-based prevalence estimates for anaemia and HIV. A representative probability sample of 10,800 households was selected. If a child in the household had a parent who was sick for more than three consecutive months in the 12 months preceding the survey or a parent who had died, additional questions related to support for orphans and vulnerable children were asked. Additionally, if an adult in the household was sick for more than three consecutive months in the 12 months preceding the survey or an adult in the household had died, questions were asked related to support for sick people or people who had died. For the individual questionnaires, 8,907 women and 7,175 men were successfully interviewed. The response rate across the four surveys is about 90%. The main reason for nonresponse was failure to find the individuals at home. Men had, on average, lower response rates due to their more frequent and longer absences from the household.

DHS are an extremely important source of information for Zimbabwe. The data provided by the DHS will be used both directly and indirectly to inform my macro and micro demographic models. Data on marital status obtained directly from the survey will be used to calibrate the microsimulation (see the appendix for nuptiality data for Zimbabwe). Indirectly, DHS are used by the United Nations, together with other data sources, to generate estimates and projections of demographic quantities for Zimbabwe.

3.4 United Nations population statistics

The United Nations compile data for most countries of the world from civil registrations, population censuses and nationally representative sample surveys. The criterion for inclusion of potential data sources is their reliability. Two main data collections, together with estimates and projections, are produced by the United Nations and provide relevant information for my research.

The *2006 Revision of the World Population Prospects* was prepared by the United Nations Population Division, and offers a consistent set of population data, estimates and projections for the world's countries. It incorporates all the relevant data sources that were available as of 2005. The database consists of all the essential fertility, mortality and migration rates and counts, by five-year age groups and sex, for the period 1950-2050. The projections are based on a series of assumptions about future trends in fertility, mortality and international migration. A number of variants are presented: for instance, low, medium, high and constant fertility, constant-mortality, no-change, zero-migration, no-AIDS, high-AIDS, etc. The No-AIDS scenario applies the mortality rates to which non infected individuals are likely to be subject, to the whole population. The high-AIDS scenario assumes that the parameters of the mathematical model for AIDS, that determine the path of the HIV/AIDS epidemic, stay constant at their 2005 level. The AIDS-vaccine scenario projects the population as if there were no new HIV infections starting from 2006.

The *World Fertility and Marriage Data 2003* was compiled by the Population Division of the United Nations Department of Economic and Social Affairs. The collection contains data for 192 countries of the world. For each country, available data are presented for two dates: an earlier date for the period between 1960 and 1985, and a later date for the most recently available data since 1986. The Fertility section of the database contains data on annual number of births, age-specific fertility rates, mean age at childbearing, etc. The Marriage section of the database contains data on total numbers of marriages, divorces, proportion of men and women ever married, and other synthetic measures, such as the singulate mean age at first marriage. For the specific case of Zimbabwe, the database provides valuable information on fertility and marriage rates, based on the census of 1982, which complement the data available through the 2006 United Nations World Population Prospects and the Demographic and Health Surveys.

Tables with relevant demographic rates, together with extrapolations from United Nations estimates and projections, are provided in the appendix.

3.5 Estimation of relevant demographic rates

In this section, I discuss some of the techniques that I used to extrapolate the relevant rates that will form the set of inputs for the formal demographic analysis of maternal orphanhood and the microsimulation.

3.5.1 Mortality rates

The United Nations provides estimates and projections of the number of deaths in Zimbabwe, in the presence and absence of AIDS, for age groups of 5 years and periods of 5 years, for the temporal interval 1980-2050. For the same period, The United Nations also publishes data on population counts for age groups of five years and periods of five years. From these data, we can calculate mortality rates and thus produce a life table. However, for the macro-demographic model based on aggregate rates, we need information at a finer level, namely for age groups and periods of one year. I thus estimated these quantities based on the available data.

First, I used a cubic spline interpolation method to estimate the number of deaths and population counts for single age groups over time. In practice, I estimated, for single age groups, the number of deaths and population counts for the mid-period year considered. For example, I obtained the mid-period number of deaths by dividing the whole number of deaths over the period by the length of the period (in years). Once I had estimates for the mid-period years, I then used a cubic spline smoother to predict the values for the years between the mid-period points. From these data I could obtain the mortality rates for the 5-year age groups considered for periods of single years.

Second, I estimated probabilities of death for single-year age groups. From the 5-year age groups mortality rates, I obtained 5-year probabilities of death (${}_4q_x$) using standard life table techniques. By assuming that, within each 5-year age group, the probabilities of death are constant, I could convert these probabilities of death into single-year probabilities of death using standard demographic techniques (see Wachter 2007 for details). A special treatment was necessary for the youngest 5-year age group, since mortality is much more likely during the first year of life than in the following four years. For the years after 1995, the United Nations provide an estimate of the probability of survival to age 1: I thus used these probabilities for the ${}_nq_x$ conversion method. For the years before 1995, I assumed that the relative probability of survival to age one, with respect to age five, is equal to the one observed in 1995.

Estimates and projections of sex-specific probabilities of survival in presence and absence of AIDS, for Zimbabwe during the period 1980-2050, are provided in the appendix.

3.5.2 Fertility rates

The UN 2006 Revision of the World Population Prospects provides estimates and projections of age-specific fertility rates in Zimbabwe for the period 1995-2050. Rates are available for women in the age range 15-49 years, for age groups and time intervals of five years. For periods before 1995, estimates of total fertility rates for Zimbabwe are provided by the United Nations. I estimated the age-specific fertility rates for Zimbabwe for the period 1980-1994 by multiplying the age-specific profile of fertility of 1995 by a scalar, in order to match the UN estimate of total fertility rate for the respective period.

In order to obtain age-specific fertility rates for age groups and periods of one year, I used a cubic spline interpolation technique, with a procedure analogous to the one used for mortality rates (see the previous section for details)

Estimates and projections of age-specific fertility rates for Zimbabwe for the period 1980-

2050 are provided in the appendix.

3.5.3 AIDS-related deaths and new HIV infections by age

From the estimates and projections of the United Nations, we can generate life tables for all causes of death, including AIDS, and life tables for causes of death other than AIDS-related causes. I use these life tables to compute the survivorship from AIDS-related causes only:

$$(1 - {}_nq_x^{ALL}) = (1 - {}_nq_x^{AIDS}) \times (1 - {}_nq_x^{OTHER})$$

Once I have obtained a life table for AIDS-related causes only, then I would like to have a picture of AIDS-related probability of dying for a cohort. I thus follow the probability of survival over time and age to have a representation of AIDS mortality for a cohort. For instance, to follow the cohort of people born in 1980, I choose ${}_nl_0^{AIDS}$ for 1980, ${}_nl_1^{AIDS}$ for 1981, ${}_nl_2^{AIDS}$ for 1982, etc. Ultimately, when I observe an increase in the ${}_nl_x$ function, I consider the ${}_nl_x$ before the increase as the ${}_nl_x^{Ultimate}$ and from there on I assume that ${}_nl_{x+1} = 0.999{}_nl_x$.

Using the estimated 'cohort AIDS life table' and the number of births for specific years, we can estimate the number of survivors from AIDS at each age, if all deaths were AIDS-related. For a specific cohort, I multiply the number of births by the survival probabilities to get the number of survivors, by age. The difference between consecutive numbers of survivors, by age, gives the number of AIDS-related deaths for each age group.

Given a cohort representation of AIDS-related deaths, we can then estimate an important quantity of interest to parameterize the microsimulation that I will present later on: the rate of new HIV-infections by age, consistent with the United Nations estimates and projection of demographic rates.

Let D^{AIDS} be a column vector containing the number of AIDS-related deaths by age for a cohort of adult individuals:

$$\begin{bmatrix} {}_1d_{15}^{AIDS} \\ {}_1d_{16}^{AIDS} \\ \cdot \\ \cdot \\ {}_1d_{50}^{AIDS} \end{bmatrix} \tag{3.1}$$

Let P be a matrix containing the probabilities of surviving exactly x years after getting infected with the HIV (p_x):

$$\begin{bmatrix} p_1 & 0 & 0 & 0 & \cdot \\ p_2 & p_1 & 0 & 0 & \cdot \\ p_3 & p_2 & p_1 & 0 & \cdot \\ p_4 & p_3 & p_2 & p_1 & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \end{bmatrix} \tag{3.2}$$

Let N^{HIV} be a column vector with new cases of HIV by age:

$$\begin{bmatrix} {}_1n_{15}^{HIV} \\ {}_1n_{16}^{HIV} \\ . \\ . \\ {}_1n_{50}^{HIV} \end{bmatrix} \tag{3.3}$$

Then, for a cohort of individuals, it holds:

$$D^{AIDS} = P \times N^{HIV} \tag{3.4}$$

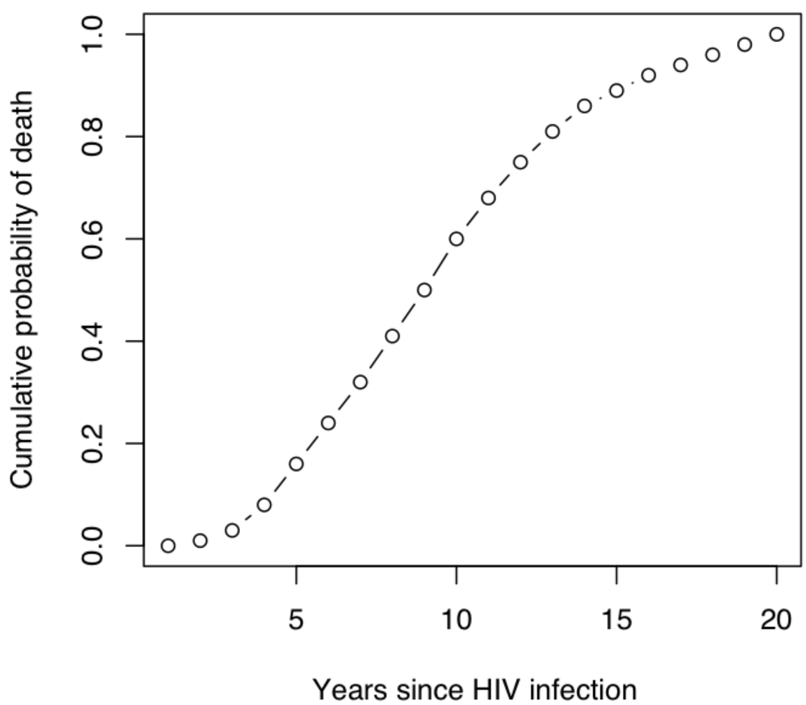

Figure 3.2: Cumulative probability of death since the time of infection with HIV. Estimates based on the UNAIDS Spectrum Estimation and Projection Package.

Previously, we obtained an estimate of D^{AIDS}. P is estimated from the cumulative probability of death since HIV infection that UNAIDS uses for the Spectrum Estimation and Projection

Package (see figure 3.2) . By combining the two quantities we can estimate N^{HIV} from equation 3.4. In particular, N^{HIV} can be estimated from a linear regression of D^{AIDS} on P. The estimated coefficients represent N^{HIV}. This model is appealing for its simplicity, but the least-squares technique may lead to unstable results. I thus performed an L1-norm regression, which provides more stable results. I then applied Friedman's smoother (Friedman 1984) to the estimated coefficients to obtain a smooth profile of new HIV infections.

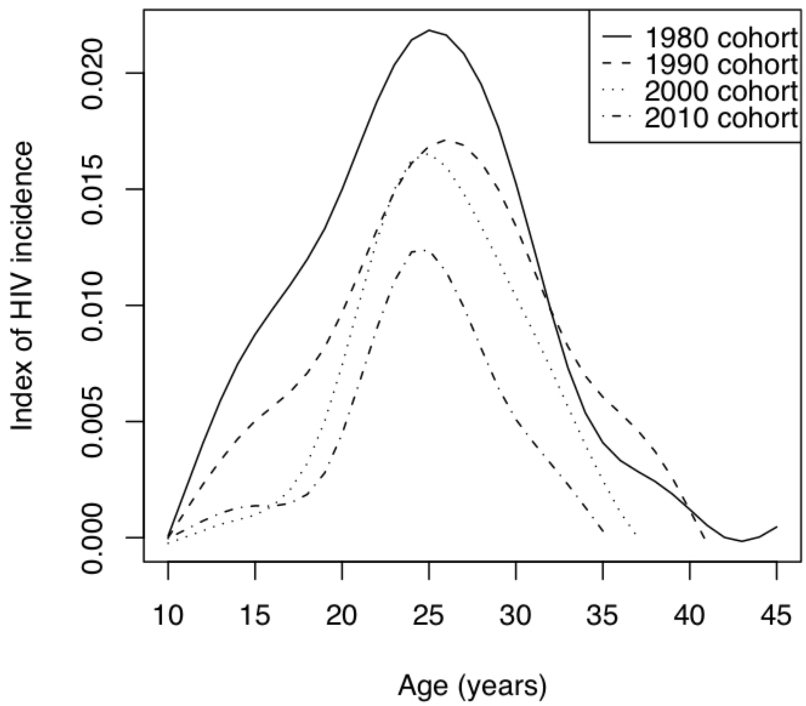

Figure 3.3: Index of female cohort HIV incidence (normalized by the initial size of the cohort) for individuals born in 1980,1990, 2000 and 2010, respectively.

Figure 3.3 is an illustrative example of the estimates for new HIV infections. It represents an index of cohort HIV incidence for females, obtained by dividing the number of new age-specific infections by the initial size of the cohort. The lines shown in figure 3.3 are the patterns for the cohorts born in 1980, 1990, 2000 and 2010, respectively. The microsimulation that I will present in chapter five uses these and analogous profiles as an initial guess for the parameterization.

3.6 Conclusions

In this chapter, first I provided some background on the Zimbabwean setting. This information complements the more general introduction of chapter two on the effect of the HIV/AIDS epidemic on orphans in sub-Saharan Africa. Second, I described the main data sources available for Zimbabwe. Finally, I discussed the methods that I used to indirectly extract relevant rates for my macro and micro models from the available data sources.

This chapter bridges the more qualitative discussion of chapter two with the empirical analysis of the next chapters. Some important data collection are available for Zimbabwe. However, for some of the applications that I will present, I need some demographic and epidemiological rates in specific forms that are not readily available. In this chapter I presented the strategies that I used to extract relevant information from the available data sources. The estimated demographic rates are presented in the appendix. These rates will be used in chapter four to parameterize the formal analysis of maternal orphanhood. In chapter five, they will be used to inform and calibrate the microsimulation model.

Chapter 4

The formal demography of maternal orphanhood

4.1 Introduction

In this chapter, I use the tools of formal demographic analysis to obtain some insights on the process of generation of orphans. In the context of a stable population, when demographic rates are constant over time, some classic results from the stable theory of kinship apply (see, for instance, Goodman, Keyfitz and Pullum 1974). The first part of the chapter deals with the application of results from the stable population theory to the context of a generalized HIV/AIDS epidemic. In the second part of the chapter, I extend the formal analysis of maternal orphanhood in two main directions. First, I consider the situation of demographic rates changing over time. Second, I analyze the effect of heterogeneity and correlations of risks of mortality between mothers and children on prevalence of maternal orphanhood.

Estimates of maternal orphanhood can be obtained directly from survey data, such as the Demographic and Health Surveys (DHS). Direct estimation of orphanhood prevalence is appealing because of its simplicity, when data are available. However, there are some drawbacks. Direct estimates do not provide any information on the processes behind the generation of orphans and therefore they are not useful to make projections or to reconstruct the historical rates. In addition, surveys typically do not give any information about relatives who are not household members.

This chapter focuses on indirect methods that rely on aggregate rates. It shows how macro-level formal analysis is useful to improve our understanding of key demographic processes. In an essay presented at the Annual Meeting of the Population Association of America in 2001, Ronald Lee reflected on the danger of demography losing its core, after observing that "we are becoming a doughnut of a field, without a center. The center should contain formal demography as a major part, closely linked to analytic description, another major part" (Lee 2001). In this chapter, I emphasize the relevance of formal demographic analysis and I discuss the insights that we can get from data at the aggregate level.

4.2 Insights from the stable population theory

4.2.1 Limiting probabilities of maternal orphanhood

A good starting point for understanding the process of orphans generation is the stable population theory. Keyfitz and Caswell (2005) discuss the stable theory of kinship with reference to the work of Lotka (1931), Burch (1970), Coale (1965), Goodman, Keyfitz and Pullum (1974) and Le Bras (1973). An important result that they present is the analytic representation of the probability that a girl aged a has a living mother $M_1(a)$, under a given regime of mortality and fertility:

$$M_1(a) = \int_{\alpha}^{\beta} \frac{l_{x+a}}{l_x} e^{-rx} l_x f_x f_{fab} dx \tag{4.1}$$

where l_x is the probability of survival to age x, f_x is the fertility rate at age x, f_{fab} is the fraction of females at birth, and r is the Lotka's intrinsic growth rate.

Using estimates and projections of vital rates for Zimbabwe for the period 1980-2050, we can compute the limiting stable probability of maternal orphanhood at age a $(1 - M_1(a))$ under different regimes of mortality and fertility. This means that, for each period of one year, we can evaluate the probabilities of orphanhood that result from the persistence of current mortality and fertility rates. In practice, this entails computing the Lotka growth rate, r, for each year, and plugging the associated demographic rates into equation 4.1 (see Wachter 2007 for details about numerically finding the value of the Lotka r).

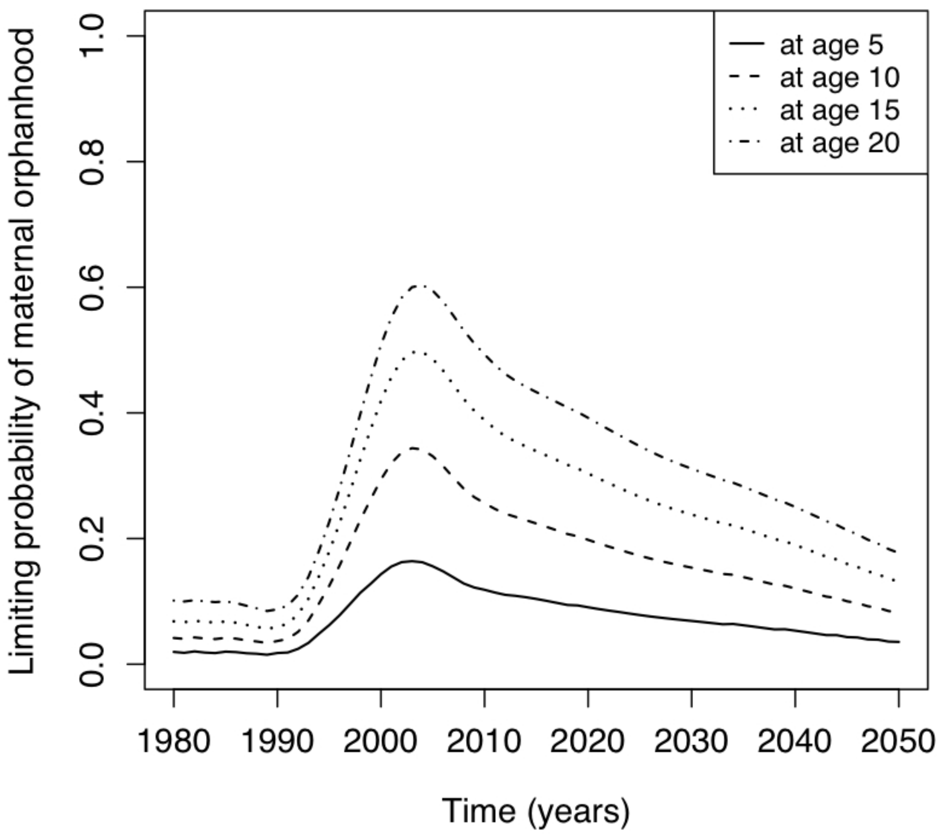

Figure 4.1: Estimates and projections of limiting stable probabilities of maternal orphanhood implied by mortality and fertility rates for selected years and ages in Zimbabwe. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

Figures 4.1 shows estimates and projection of limiting maternal orphanhood probabilities for Zimbabwe. The estimates for each year in time are generated assuming that the age-specific mortality and fertility rates for the year considered will persist unchanged in the future. The figure shows the considerable impact of the HIV/AIDS epidemic on the probability of maternal orphanhood. For instance, the estimated probability of maternal orphanhood at age 10 is 0.04 in 1990. With the rapid increase in the number of AIDS-related deaths, this probability rapidly grows to 0.12 in 1995, 0.29 in 2000, up to 0.34 in 2004, before slowly decreasing, in accordance with the projected demographic rates. The same pattern characterizes the probability of maternal orphanhood at other ages.

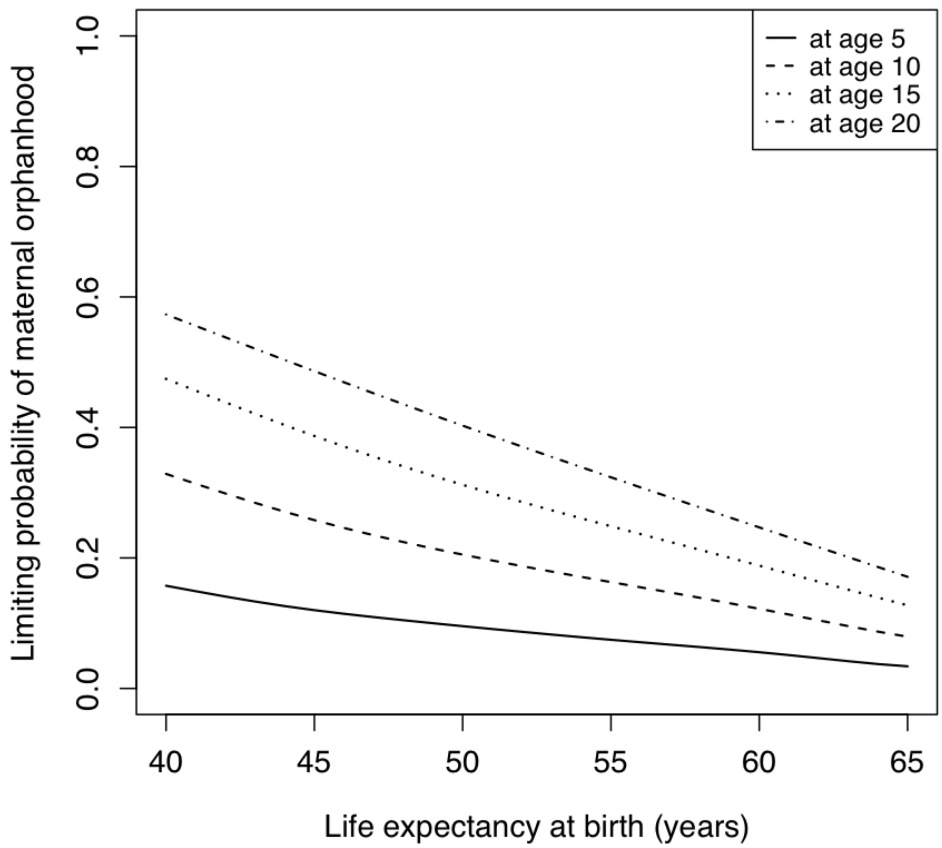

Figure 4.2: Estimates of limiting stable probabilities of maternal orphanhood associated to different levels of AIDS-related life expectancy at birth in Zimbabwe. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

Figure 4.1 gives a representation of the impact of the HIV/AIDS epidemic over time and age. It is also interesting to understand the impact of AIDS-related changes in life expectancy on the probability of maternal orphanhood. If we choose an index of the level of mortality, then we can determine the effect of a unitary change in the index on $M_1(a)$. It is the first derivative of $M_1(a)$ with respect to the index of mortality. For example, we can fit a model life table, such as the Brass relational logit model (Brass 1974), to the estimates and projections of Zimbabwean mortality rates for the period 1980-2050. We can choose the life table for the year at the beginning of the period under consideration and make it our standard for the Brass relational model. Then we estimate the shape and level parameters of the model over time and we link them to different levels of life expectancy. We can thus relate couples of estimated parameters (α, β) to an index of mortality i, such that $\frac{\partial e_0}{\partial i} = 1$, and estimate the impact of a change in the index i on the probability of maternal orphanhood at age a. Analytically, this entails computing $\frac{\partial M_1(a)}{\partial i}$, a quantity that varies according to the initial level of life expectancy and the age groups that are mostly affected by the change in mortality patterns (under a generalized HIV/AIDS epidemic, a reduction in life expectancy is driven by an increase in adult mortality, rather than infant or old age mortality).

The approach that I just described is appealing, but it has a major limitation. The Brass model does not fit mortality profiles typical of the HIV/AIDS epidemic very well. After obtaining unsatisfactory results from the use of the Brass model, I decided to opt for a different method to evaluate the effect of changing life expectancy on $M_1(a)$. I looked at my estimates and forecasts of the probabilities of maternal orphanhood associated to different levels of life expectancy for the period 1990-2050, and I used a cubic spline smoother to interpolate these probabilities for missing values of life expectancy. Figure 4.2 shows the estimated probabilities of maternal orphanhood at age 5, 10, 15 and 20, respectively, associated to values of life expectancy between 40 and 65. As expected, higher levels of life expectancy are associated to lower orphanhood probabilities. It is also interesting to note that the slope of the lines is higher when evaluated at lower levels of life expectancy. This means that an improvement in life expectancy of one year, from a starting level of 40 years, generates a larger reduction in probabilities of orphanhood than an analogous improvement from a starting level of 60 years of life expectancy.

4.2.2 Approximations of probabilities of maternal orphanhood in the context of a generalized HIV/AIDS epidemic

If the maternity function is relatively concentrated around the mean age at childbearing, then the probability that a girl who is a years old has a living mother should be mainly determined by the probability of surviving a years past the mean age at childbearing. This intuition is behind an analytical approximation of $M_1(a)$, presented by Keyfitz and Caswell (2005). In this section, I will discuss that approximation in the context of a generalized HIV/AIDS epidemic. The use of an approximation for the specific context that we are considering highlights the role that key demographic quantities have in shaping the probability of maternal orphanhood.

Keyfitz and Caswell (2005) showed that $M_1(a)$ can be approximated using a Taylor expansion of l_{x+a}/l_x around κ, the mean age at childbearing:

$$M_1(a) \approx \frac{l_{\kappa+a}}{l_\kappa} + \frac{\sigma^2}{2}(\frac{l_{\kappa+a}}{l_\kappa})'' \tag{4.2}$$

where σ^2 is the variance of ages at childbearing, and $(l_{\kappa+a}/l_\kappa)''$ is the second derivative of l_{x+a}/l_x evaluated at $x = \kappa$.

Let us now consider the probability that a girl aged a does not have a living mother. Following equation 4.2, an approximation of this quantity can be written as:

$$1 - M_1(a) \approx 1 - \frac{l_{\kappa+a}}{l_\kappa} - \frac{\sigma^2}{2}\left(\frac{l_{\kappa+a}}{l_\kappa}\right)'' \tag{4.3}$$

Equation 4.2 and 4.3 show that, to a linear extent, $l_{\kappa+a}/l_\kappa$ is a good approximation to $M_1(a)$. The two main factors affecting the accuracy of the approximation are the variance of ages of mothers and the concavity of the survivorship function.

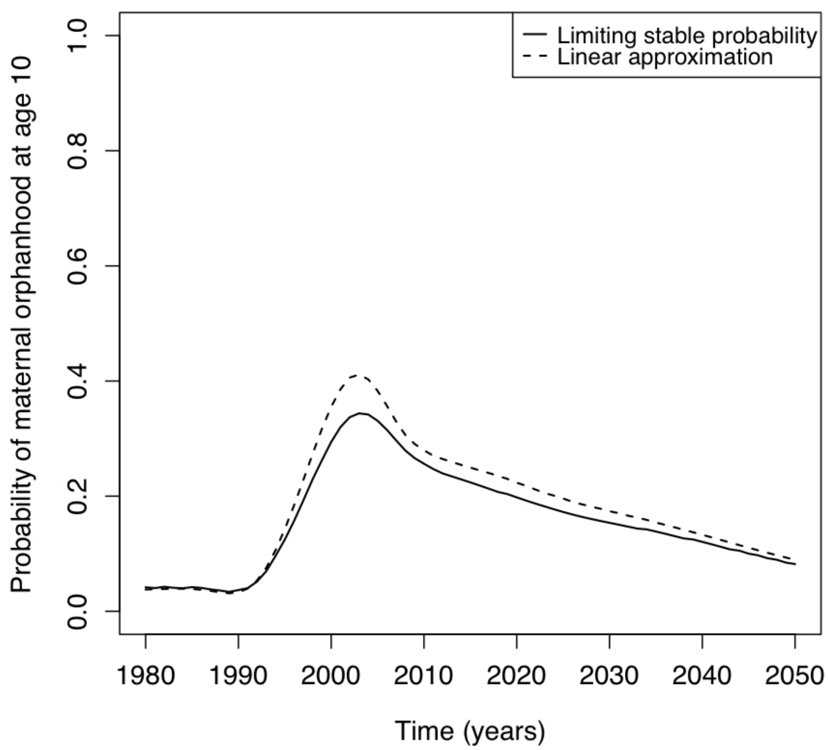

Figure 4.3: Estimates and projections of limiting stable probabilities of maternal orphanhood at age 10, in Zimbabwe, and the respective approximations based on Taylor expansion. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

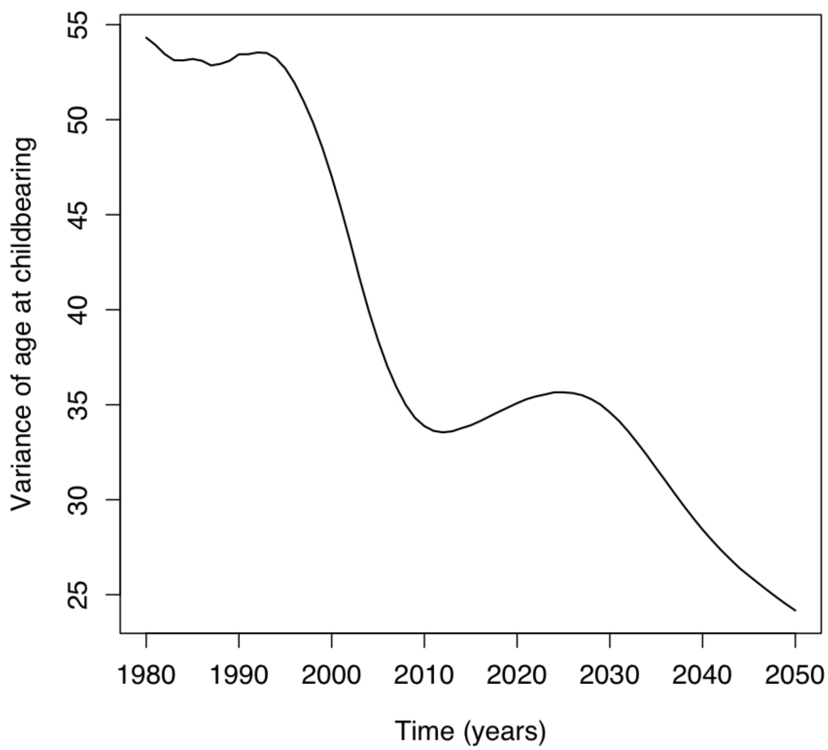

Figure 4.4: Estimates and projections for the variance of the age at childbearing in Zimbabwe, from 1980 to 2050. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

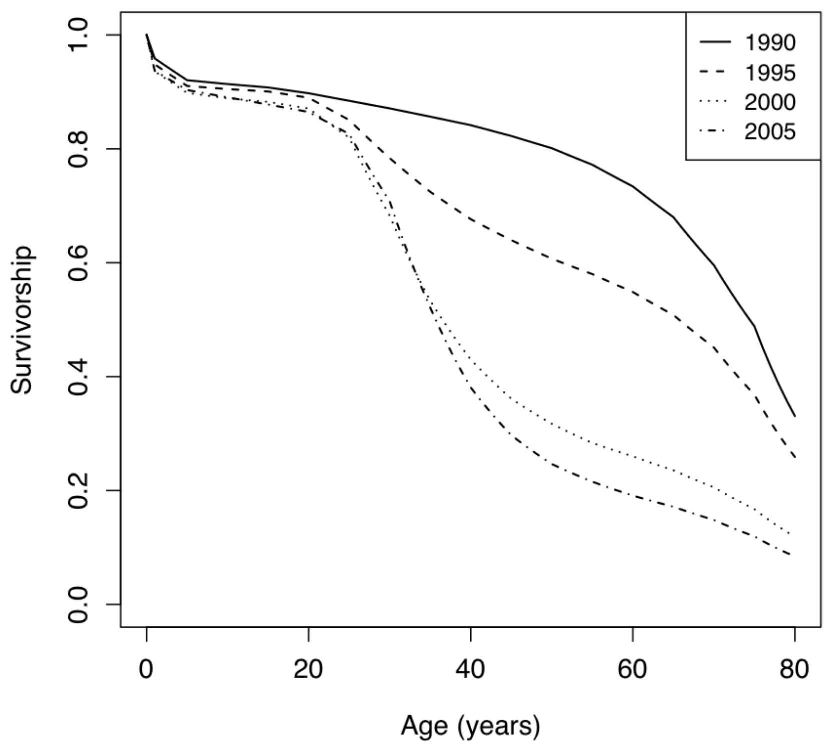

Figure 4.5: Estimates of female survival probabilities for selected years in Zimbabwe, in presence of HIV/AIDS. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

Figure 4.3 shows the evolution over time of the probability of maternal orphanhood at age 10. Both the stable limiting probability and its linear approximation $(1 - \frac{l_{\kappa+10}}{l_\kappa})$ are presented. It is interesting to observe that the approximation is fairly accurate for the period from 1980 to the early 1990s. Then the approximation tends to systematically overestimate the exact value for the probability of orphanhood. This is related to the two factors mentioned earlier: the variance of the age at childbearing and the concavity of the survivorship function. Figure 4.4 shows the evolution over time of the variance of the age at childbearing. Figure 4.5 shows the female survival probabilities for selected years in Zimbabwe. Until the end of the 1980s, the survival function is concave at adult ages and its second derivative is thus negative. This makes the product $\frac{\sigma^2}{2}(\frac{l_{\kappa+a}}{l_\kappa})''$ negative and thus the linear approximation underestimates the exact value for the probability of orphanhood. Starting from the mid-1990s, we observe that the variance of the age at childbearing substantially decreases, except for a hump in the 2020s. We would expect the linear approximation to become increasingly more accurate. That is true until the mid-1990s, but it is not the case afterwards. The main reason is that the HIV/AIDS epidemic has completely transformed the shape of the survivorship function. The absolute value of the second derivative of the survivorship function, evaluated at the mean age at childbearing, decreases over time until the mid-1990s, when there is a change in sign of the second derivative, and then it rapidly increases. After the mid-1990s, the survivorship function becomes convex, thus explaining the overestimation of the exact value of the probability. In addition to that, the rapid increase in the value of the second derivative of the survivorship function more than counteracts the reduction in the variance of the age at childbearing, thus making the approximation less accurate.

In this section, I discussed how we can think of maternal orphanhood probabilities in terms of survivorship past the mean age at childbearing. The simple approximation that is quite accurate in most scenarios, is not suitable for the context of the HIV/AIDS epidemic. In particular, two key demographic quantities, the variance of the age at childbearing and the concavity of the survival function, are large enough to make the nonlinear terms of the approximation relevant.

4.2.3 A stylized representation of maternal orphanhood

So far, I have focused my attention on the use of the theory of stable population to get insights on the impact of the HIV/AIDS epidemic on limiting probabilities of maternal orphanhood. In the previous sections, I considered the computation of orphanhood probabilities based on demographic rates for Zimbabwe, and I discussed an approximation of these quantities. In this section, I would like to further develop on the intuition behind the approximation that orphanhood probabilities are related to survival past the mean age at childbearing. For illustrative purposes, I will discuss the insights that we can get from an extremely simplified representation of the process of orphan formation.

Let us a consider a female population of adults who get infected with HIV at some point in their lives. Two demographic quantities are crucial in the explanation of related orphanhood probabilities: the age at childbearing (a_c) and the age at death (a_d) for causes associated to HIV infection. The age at death mainly depends on the age at infection with HIV, the incubation period from the infection to the development of AIDS, and the period from development of AIDS to death. For simplicity, and for practical purposes, I consider the incubation period and the period between development of AIDS and death as one period. I define this quantity lid, the length of infection before death. We have that $a_d = a_{hiv} + lid$, where a_{hiv} is the age at infection with HIV.

Let M be the difference between the age at death and the age at childbearing ($M = a_d - a_c = a_{hiv} + lid - a_c$). We can think of M as a random variable representing the number of years a hypothetical child spends with a living mother, given that the mother acquires HIV infection sometimes during her life. If M is negative, the woman had died before having the child. This death implies a reduction in the number of newborns, who are also potential orphans.

Assuming independence between the components of the age at death and age at childbearing, we have that the expected value of M is given by:

$$E[M] = E[a_{hiv}] + E[lid] - E[a_c] \tag{4.4}$$

The variance of M is:

$$Var[M] = Var[a_{hiv}] + Var[lid] + Var[a_c] \tag{4.5}$$

The expected value of M tells us approximately for how many years on average a child has a living mother. The variance for M gives us an idea of the uncertainty about the number of years a chid is expected to have a living mother. In absence of any other information, we can use the Chebishev inequality to evaluate the probability that M is less than zero or that M is bigger than 15. If M is less than zero, the woman has died before having the child. If M is bigger than 15, the child has lived at least the first 15 years of his/her life with a living mother.

The Chebishev inequality can be used to obtain information on one side of the distribution of the random variable, if the distribution is symmetric. Given our hypotheses on the random variables considered, we cannot necessarily make such an assumption and the use of the Chebishev inequality is mostly for illustrative purposes. What is interesting to observe is that with the increase in the variance of M, which is ultimately related to an increase in the variance of its components, we have an increase in the probability of 'extreme' events, which implies a reduction in births of potential orphans and a reduction of those children who have a living mother for less than 15 years.

The same intuitive conclusion can be obtained using a normal approximation. M is composed of three random variables. Each of these variables can be reasonably modeled with a gamma distribution. In the three cases, the distributions are characterized by shape parameters which are fairly large. Therefore, these gamma distributions can be well approximated by normal distributions. M can thus be seen as a sum of normal distributions with mean and variance given by the expressions in equations 4.4 and 4.5, respectively. We can thus compute the probability that M is less than zero or bigger than 15 using the normal distribution.

The very simple analytical scheme depicted in this section provides some important insights with regard to orphanhood probabilities related to the onset of the HIV/AIDS epidemic. First, the higher the expected value of the age at infection and the incubation period, relatively to the expected value of the age at childbearing, the higher the chances that a child would live throughout his childhood with a living mother. [1]

[1] This reasoning would not hold if people got infected very early in life and the incubation periods were so short that virtually everyone would die before reaching childbearing age.

The second important observation is that the variance of the age at infection, the age at childbearing and the incubation period play an important role in shaping the probabilities of orphanhood. The larger the sum of these variances, the less important the values of their means are in determining the probabilities of orphanhood. If both age at childbearing and age at death from AIDS have very small variances, then most children will likely have a living mother for a number of years equal to the difference between the two random variables. If the variance of the age at childbearing is large, then we would observe some children living throughout childhood with a living mother and some others losing their mother while very young.

The reasoning developed in this section derives from the assumption that the random variables under consideration can be modeled with a Gamma distribution. Although this could be a good approximation, variables such as the age at childbearing are bounded between certain values. For a more realistic representation of the demographic processes involved, generalizations of Beta distributions could be used instead. The discussion in this section is mostly for illustrative purposes, the main intention being to highlight some intuitions related to the process of orphans formation. Later on in the chapter I will address more in depth other relevant questions such as the effect of changing rates over time and heterogeneity.

4.3 Probabilities of maternal orphanhood when vital rates evolve over time

Keyfitz and Caswell (2005) show that the problem of evaluating the probability of orphanhood at a given age may be approached using a renewal equation. In particular, the number of living mothers for girls aged a at time t is given by:

$$\int_{\alpha}^{\beta} B(t-a-x) l_x f_x f_{fab} \frac{l_{x+a}}{l_x} l_a dx \tag{4.6}$$

where $B(t-a-x)$ stands for female births at time $t-a-x$.

In equation 4.6, it is implicitly assumed that mortality and fertility rates are constant over time. If instead we assume that vital rates change over time, and we have estimates and projections of these rates for a rather long period of time, we can use different sets of fertility and survivorship schedules in order to account for the fact that mothers and daughters at different periods of time experience different fertility and mortality conditions. In this case, the number of living mothers to girls aged a at time t is:

$$\int_{\alpha}^{\beta} B(t-a-x) l_x(t-a-x) f_x(t-a-x) f_{fab} \frac{l_{x+a}(t-a-x)}{l_x(t-a-x)} l_a(t-a) dx \tag{4.7}$$

The elements between parentheses in expression 4.7 are to be intended as the year of birth of the cohort members to which the rates apply. Expression 4.7 is appealing, but there are two main limitations to its practical application. The first one is that data series that extend far back in the past and future are required. For instance, we need to know the number of births of prospective mothers in the past, their survival probabilities and fertility schedules, and the survival probabilities of recently born children up to the age of interest. The second limitation is that the approach relies on cohort data, that is a longitudinal representation of fertility histories and hazards of mortality.

The two limitations can be overcome by re-writing expression 4.7. As a matter of fact, orphanhood probabilities can be evaluated using estimates and projections of demographic rates over time provided by the United Nations. With regard to the first limitation, it is important to observe that we do not need to go as far back in time to keep track of the number of births for the cohorts of prospective mothers. The relevant information that we need to know is the probability of the age of a woman who gave birth to a child a years before the time of reference. This probability depends on the age structure of the population and the age-specific fertility rates in place a years before the time of reference. Let A_b be the age at giving birth for a woman. Then the probability that the age at giving birth for a woman a years before the time of reference is equal to x, $P(A_b = x, t - a)$, is given by the proportion of births to women of age x, a years ago:

$$P(A_b = x, t - a) = \frac{{}_1f_x(t-a) \times {}_1K_x^f(t-a)}{\sum_{x=0}^{100} {}_1f_x(t-a) \times {}_1K_x^f(t-a)} \tag{4.8}$$

Equation 4.8 is expressed in discrete terms. Although a continuous representation of the equation is more compact and elegant, a discrete one is presented to be consistent with the empirical analysis which is carried out in discrete terms. Figure 4.6 shows the evolution over time of the probability of mother's age at childbirth in Zimbabwe. We observe that with the onset of the HIV/AIDS epidemic, the probability of giving birth at an earlier age increases. Projections for the next decades show that the age at childbearing will increase. This is consistent with the estimated mean ages at childbearing over time, as they appear in figure 4.7

With regard to the second limitation, that is the absence of cohort data, we can estimate approximate cohort histories from period data. For instance, using demographic rates provided by the United Nations, we can generate a rectangular array of probabilities of surviving n years past age x, $(\frac{l_{x+n}}{l_x})$. This array will typically have rows representing age and columns representing years. By looking at the array over diagonals, we consider rates that apply to the same cohort of individuals and we can thus have a picture of cohort histories.

The probability that at time t a child aged a randomly selected from the population has lost his/her mother is given by the probability that his/her mother has not survived a years past giving birth to the child considered:

$$[1 - (\sum_{x=0}^{100} \frac{l_{x+a}(t-x-a)}{l_x(t-x-a)} \times P(A_b = x, t-a))] \tag{4.9}$$

Expression 4.9 gives the probability that a child standing in front of us has lost her mother, when we do not account for the survival probabilities of the child. Expression 4.9 is a weighted average of the probabilities of surviving a years past childbearing, where the weights are the probabilities of giving birth at a specific age.

Figure 4.8 shows estimates and projections of maternal orphanhood probabilities over time for a randomly selected child of age 5, 10, 15 and 20, independently of children survival.

If we want to account for the fact that some children will not survive long enough to become orphans and we thus want to compute the probability that a random newborn will be

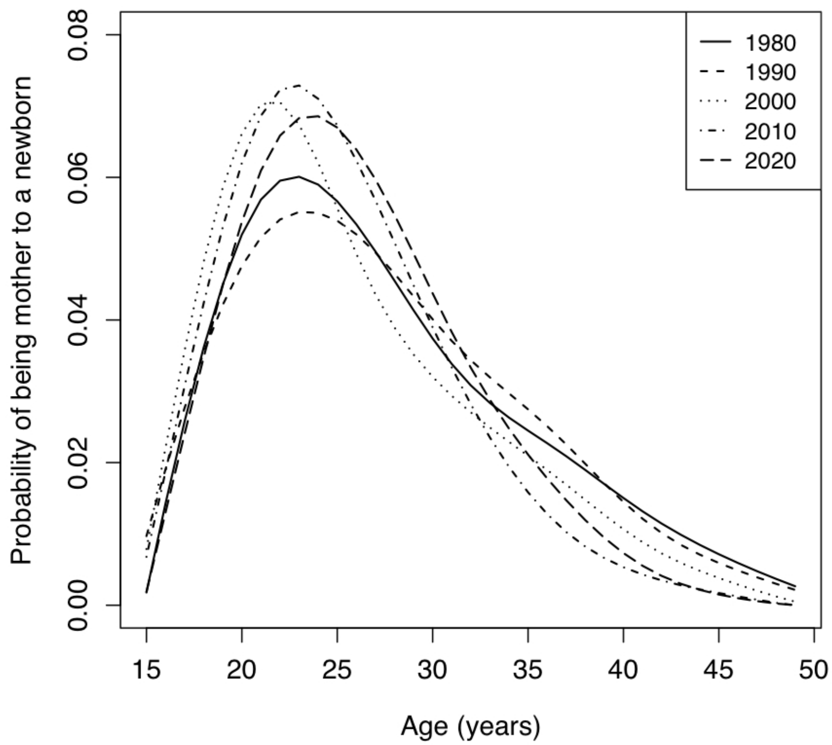

Figure 4.6: Estimates and projections of probabilities of mother's age at childbirth in Zimbabwe, over time. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

orphan at age a, then we need to take into account the survival probabilities of children. The probability that at time t a child of age a is alive, whereas his/her mother is not becomes:

$$l_a(t-a) \times [1 - (\sum_{x=0}^{100} \frac{l_{x+a}(t-x-a)}{l_x(t-x-a)} \times P(A_b = x, t-a))] \tag{4.10}$$

Figure 4.9 shows estimates and projections of maternal orphanhood probabilities over time for a child of age 5, 10, 15 and 20. These estimates account for the survival probability of the child.

The results showed in figures 4.8 and 4.9, although different in scale, provide the same general picture for the trend in probabilities of orphanhood for the future. It is interesting to note how the generation of orphans is a process with a lag with respect to the generation HIV cases. In the previous section, we observed the probabilities of orphanhood implied by the persistence of specific conditions over time. We saw that the highest probabilities of orphanhood are implied by

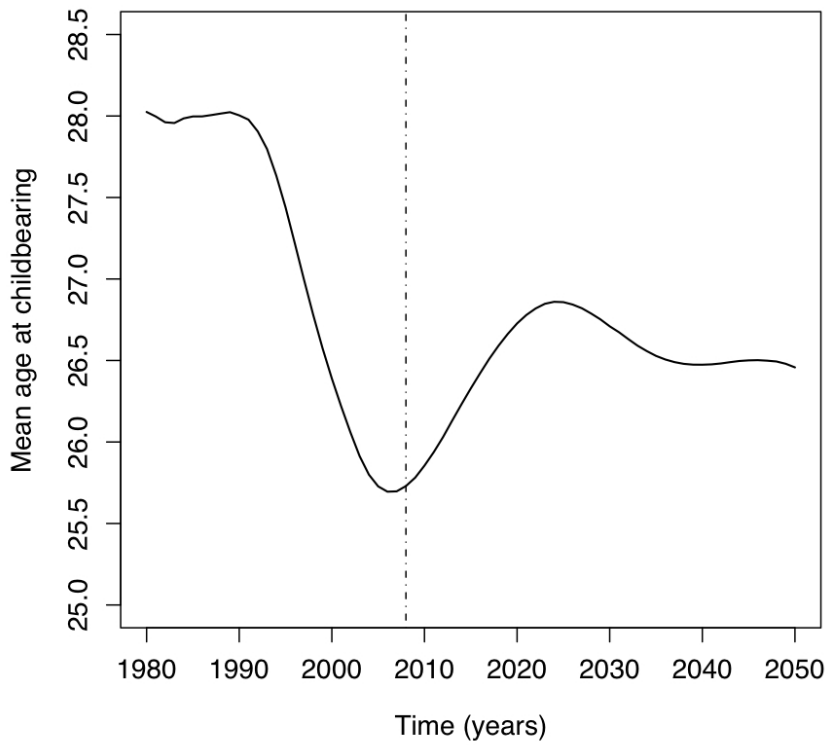

Figure 4.7: Estimates and Projections of mean age at childbearing for Zimbabwe, from 1980 to 2050. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

the persistence of the conditions at the peak of the HIV epidemic. Here we see how the consequences of a peak in the HIV epidemic on generation of orphans persist for a rather long period of time past the reduction in HIV prevalence. After reaching the peak in the epidemic, the probability of being orphan at age 5 decreases more quickly than the probability of being orphan at age 15. With the reduction in AIDS-related deaths, the most recently born cohorts of children are less likely to become orphaned. For the older children, the probability of being orphan is more related to the conditions in the past, as the probability of being orphan at a specific age is the cumulative result of the probabilities of being orphan at previous ages. These results indicate that with the containment of the epidemic, the scale of the orphanhood problem may become smaller for young children, but may continue to be a pressing problem for teenagers.

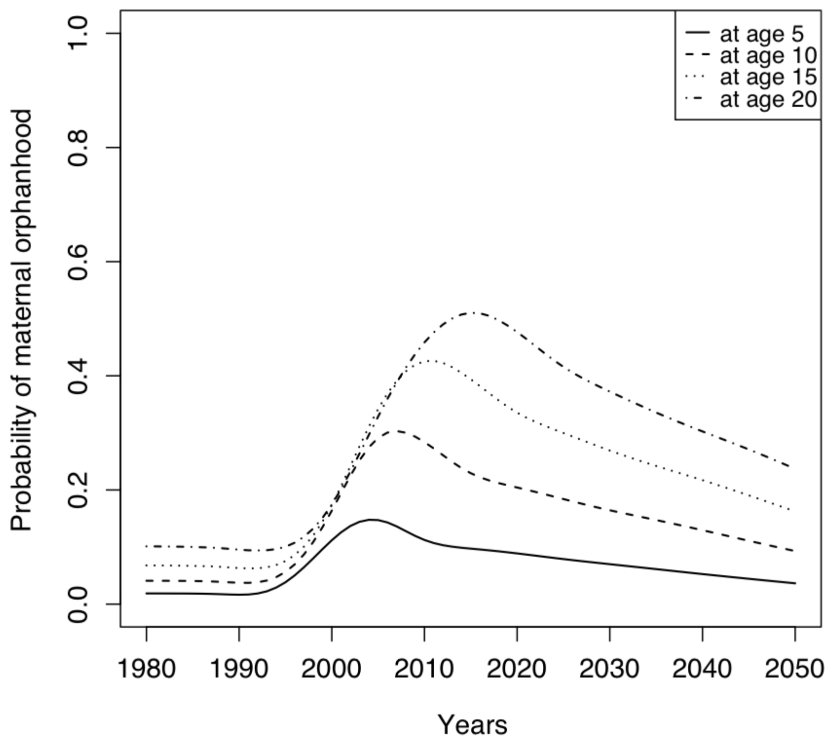

Figure 4.8: Estimates and Projections of maternal orphanhood probabilities for children, given that they are alive, at age 5, 10, 15, 20 in Zimbabwe (1980-2050). Data source: own elaborations on UN World Population Prospects, 2006 Revision.

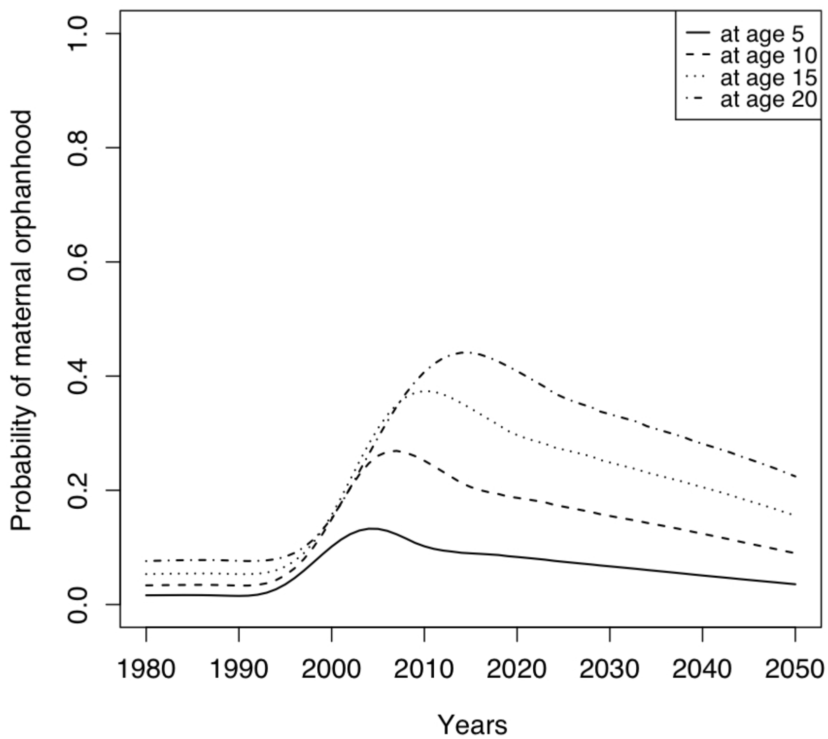

Figure 4.9: Estimates and Projections of maternal orphanhood probabilities for children, given that they are alive, at age 5, 10, 15, 20 in Zimbabwe (1980-2050). Data source: own elaborations on UN World Population Prospects, 2006 Revision.

4.4 Estimation and projection of the number of maternal orphans

I previously considered the problem of estimating probabilities of orphanhood at different ages. It is also important to quantify the scale of the orphanhood problem and to provide estimates and projections of absolute numbers of orphans. In this section, I develop on the ideas that I discussed earlier in the context of stable population theory, and I suggest an approach to the estimation of the number of maternal orphans.

The United Nations World Population Prospects provide demographic rates for virtually all countries in the world in a standardized format. Here I propose a method to use this data set to estimate and project the number of maternal orphans over time. I will provide estimates for Zimbabwe, which are informative for the specific geographic setting. The relevance of the method is that can be easily applied to virtually all countries in the world and requires only demographic rates that are readily available. The main drawback of the method is that estimates may be less accurate than the ones obtained using several different data sources and epidemiological models.

The United Nations provides estimates and projections of population counts by age and sex, and age-specific fertility rates. Based on that information, it is straightforward to estimate the number of births to mothers of age x at time t ($B_x(t)$). Orphans of age a at time t are children who were born a years before time t, who survived a years and whose mothers have not survived a years past giving birth to them. The number of maternal orphans of age a at time t (MO_a^t) can be expressed as a weighted average of the number of births a years before time t, where the weights are the survival probabilities of children and their mothers:

$$MO_a^t = (1 - {}_aq_0(t-a)) \sum_{x=15}^{49} B_x(t-a) \times {}_aq_x(t-x-a) \tag{4.11}$$

The expressions between parentheses refer to the year of birth of the members of the cohort to which the demographic quantities apply. The idea behind this estimation procedure is to follow the same group of people over time and age in order to have demographic rates that give a longitudinal representation of life histories.

In some cases, it is interesting to know the overall number of maternal orphans in a specific age group at time t. For instance, UNICEF and other international organizations report estimates of orphans in the age group 0-17 years. This quantity, MO_{0-17}^t, can be easily computed as:

$$MO_{0-17}^t = \sum_{a=0}^{18} MO_a^t \tag{4.12}$$

I applied equations 4.11 and 4.12 to data for Zimbabwe. Figure 4.10 shows estimates and projections of the number of orphans in the age group 0-17 years for the period 2000-2050. We observe a rapid increase in the number of maternal orphans between 2000 and 2010. Maternal orphans in Zimbabwe will continue to increase and will be more than 1 million between 2010 and 2020. Although HIV incidence is expected to steadily decline after a peak between 2000 and 2010, the consequences of the epidemic on orphanhood will be felt for decades. The number of maternal orphans are expected to slowly decrease only after 2030.

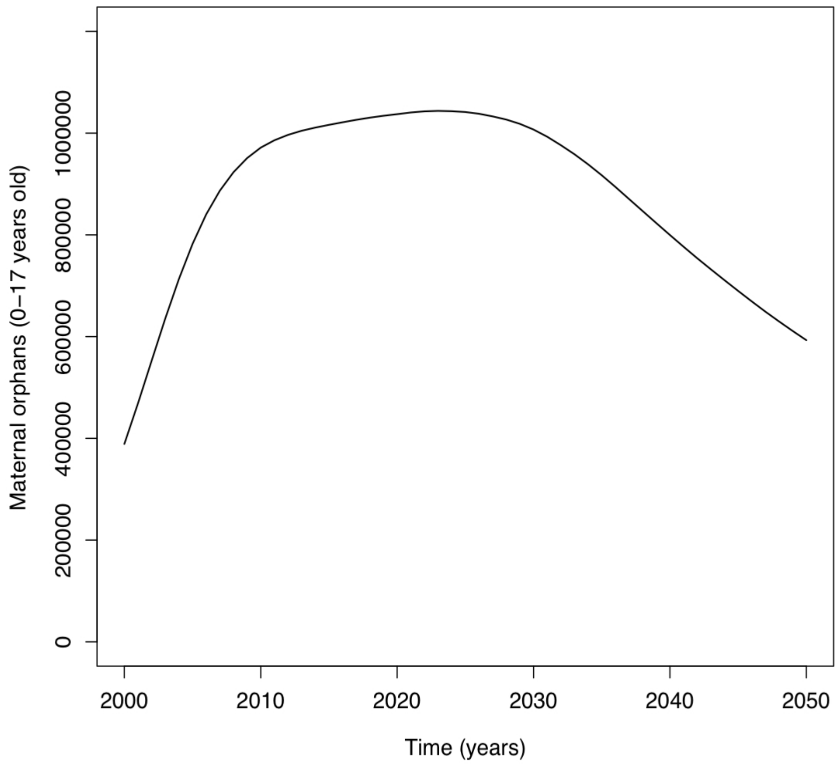

Figure 4.10: Estimates and projections of the number of maternal orphans who are between 0 and 17 years in Zimbabwe during the period 2000-2050. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

UNICEF does not provide estimates and projections of maternal orphans over a long period of time. In the 2006 report on children affected by AIDS, UNICEF reported for Zimbabwe an estimated number of orphans (both maternal and paternal) of 1.4 millions in 2005 and a projected number of 1.3 millions for 2010 (UNICEF 2006). The estimated number of maternal orphans for Zimbabwe for 2005 reported by UNICEF is 1.1 millions, whereas paternal orphans are estimated to be 0.92 millions and double orphans 0.7 millions. More recent estimates of UNICEF for total orphans in 2007 show a value of 1.3 millions for Zimbabwe. This value is consistent with a downward revision of the estimated number of orphans as a consequence of a downward revision in the estimates of HIV prevalence within the UN system. Altogether, estimates reported by UNICEF seem to be slightly higher than the ones obtained using the mathematical model based on demographic rates. The discrepancies may be due to different underlying assumptions about HIV prevalence, or may reflect randomness (UNICEF provides point estimates for maternal orphans only for one year). Independently of discrepancies that we may observe when we estimate the same quantities from different data sources (see, for instance, Robertson et al. 2008), the key message that emerges is that, even under the assumption of a fairly rapid reduction in HIV prevalence rates, the number of orphans in Zimbabwe will not decrease for at least a couple of decades.

4.5 The effect of heterogeneity on maternal orphanhood

In the previous sections, I discussed how the mathematical demography of kinship is useful for understanding the process of generation of maternal orphans. I then suggested an approach to estimate maternal orphans solely on the basis of demographic rates. The main advantage of estimating and forecasting orphans on the basis of aggregate demographic rates is that estimates and projections of those rates are widely available and allow for comparative analyses.

An important limitation of a procedure based on aggregate data is that the underlying population is implicitly assumed to be homogeneous, with the same set of rates that apply to everyone who belong to a specific age group. With the onset of the HIV epidemic, the assumption of homogeneity is strongly challenged. In this section, I deal with the issue of incorporating heterogeneity in mathematical models that rely on aggregate demographic quantities.

Modeling heterogeneity is based on the idea that each person may be subject to an individual-specific hazard rate. Some people may be weaker than others and experience higher probability of death throughout their entire lives. Some people may be stronger and experience probabilities of death consistently lower than the average. The hazard rate observed at the population level is an average of all individual-specific rates. In the context of the HIV/AIDS epidemic, we may expect that some people are more at risk than others of becoming infected with HIV. As a consequence, their probability of death is higher. The risk of mortality for their children would be higher too: they may have higher probabilities of becoming infected with HIV (e.g., through perinatal transmission) or they may be more vulnerable because they are likely to be orphans or to spend a portion of their childhood with little resources and a sick parent.

A convenient way of introducing heterogeneity in models for survival data is to allow for hazard rates to be different across individuals, according to proportionality factors that are individual-specific. These proportionality factors have become popular under the name of 'frailties', after Vaupel, Manton and Stallard (1979) formalized some ideas on using frailties for survival analysis, to get insights on the dynamics of mortality and aging populations. Some developments of the pioneering approach allow for correlated frailties (e.g., Yashin, Vaupel and Iachine 1995): the idea is that there may be correlations in the factors that multiply the hazard rates, associated to certain individual characteristics related to genetic pool, socio-economic status, etc.

In the previous section, with equation 4.11, I introduced a formula for estimating the number of maternal orphans of age a at time t, MO_a^t. Equation 4.11 can be written in terms of hazard rates:

$$MO_a^t = e^{-{}_aH_0(t-a)} \sum_{x=15}^{49} B_x(t-a) \times (1 - e^{-{}_aH_x(t-x-a)}) \tag{4.13}$$

where ${}_aH_x$ is the cumulative hazard rate from age x to age $x+a$ (i.e., ${}_aH_x = H_{x+a} - H_x$). The expressions between round parentheses refer to the year of birth of the members of the cohort to which the demographic quantities apply.

Assume that the hazard rate for each child and each mother in the population are proportional to the average hazard rate that we observe at the population level, for the respective groups, and that the coefficients of proportionality are positive random variables, z_c and z_m for children and mothers respectively. The expected value of the frailties z_c and z_m has to be equal to 1, so that the average hazard rates for the overall population are consistent with the aggregate ones. We also expect the frailties z_c and z_m to be correlated. Higher mortality risks for mothers, due to HIV infection or bad sanitary conditions, etc., are likely to be associated with high mortality risks for their children, since the mother and the child supposedly live in the same geographic area and there is the possibility of perinatal transmission of HIV.

By including frailties in the analysis, we can re-write equation 4.13 as:

$$MO_a^t = e^{-(z_c)_a H_0(t-a)} \sum_{x=15}^{49} B_x(t-a) \times (1 - e^{-(z_m)_a H_x(t-x-a)}) \tag{4.14}$$

or, equivalently:

$$MO_a^t = \sum_{x=15}^{49} (B_x(t-a) \times e^{-(z_c)_a H_0(t-a)}) - (B_x(t-a) \times e^{-(z_c)_a H_0(t-a) - (z_m)_a H_x(t-x-a)}) \tag{4.15}$$

To get some insights on the role of heterogeneity within a population, we can focus on a specific component of equation 4.15: $e^{-(z_c)_a H_0(t-a) - (z_m)_a H_x(t-x-a)}$. This component gives the proportion of births that survive to age a with a living mother. If we derive a second order Taylor expansion for the component of interest, we obtain a linear expression from which we can calculate the expected value (omitting the indexes between round parentheses for readability purposes):

$$\begin{aligned} E[e^{-(z_c)_a H_0 - (z_m)_a H_x}] &\approx 1 - {}_aH_0 - {}_aH_x + \frac{1}{2}(({}_aH_0)^2 + {}_aH_{0a}H_x)E[{z_c}^2] + \\ &+ \frac{1}{2}(({}_aH_x)^2 + {}_aH_{0a}H_x)E[{z_m}^2] + \\ &+ \frac{1}{2}(({}_aH_0)^2 + ({}_aH_x)^2 + 2{}_aH_{0a}H_x)E[z_c z_m] \end{aligned} \tag{4.16}$$

We observe that the expected value of $e^{-(z_c)_a H_0 - (z_m)_a H_x}$ is related to E$[{z_c}^2]$, E$[{z_m}^2]$ and E$[z_c z_m]$, which are proportional to, respectively, the variance of z_c, the variance of z_m and the covariance of z_c and z_m. In other words, the larger the heterogeneity in the population and the larger the covariance between the frailty of the mother and the one of her children, the higher the proportion of births that survive to age a with a living mother. When risks of mortality are correlated between mother and children, and having a specific disease, such as HIV/AIDS, highly increases the probability of death for a subgroup of the population and for their children, then it is more likely to observe that either both the mother and the child survive or they both die within a years from the birth of the child. The probability of maternal orphanhood (the child survives, but not the mother) is reduced in the context of a heterogeneous population with positively correlated frailties, compared to a homogeneous population. The reason for this reduction is a high level of mortality for a subgroup of the population.

4.6 Estimation of other kinship quantities

In the previous sections, I discussed and estimated probabilities of maternal orphanhood in Zimbabwe at different ages and for different periods of time. There are other relevant quantities of interest, such as the expected number of siblings or aunts available to children, or the probability that a specific number of siblings or aunts are available to children (either orphans or not). It is not the purpose of this chapter to discuss those quantities in detail, and to provide estimates based on an analytical model. A full quantitative description of the kinship structure and the kinship resources available to orphans will be obtained using a microsimulation model. In this section, I will give a brief introduction on how to approach the problem of estimating analytically the availability of kinship resources for orphans.

We can compute the probability that, at time t, a child of age a has k living older siblings (brothers or sisters), $P(S_a = k)$, using either data on age-specific parity or age-specific fertility rates. When data on parity are available (for instance from sample surveys such as the DHS), we can compute such probability as:

$$\begin{aligned} P(S_a(t) = k) &= l_a(t-a) \times \sum_{x=0}^{100} P(Parity_{age_{x-1}}(t-a-1) = k) \times \\ &\times \ P(A_b = x-1, t-a-1) \times E[\prod^{k} l_{j+a}(t-a-j)] \end{aligned} \tag{4.17}$$

where js are random integer numbers drawn with replacement in the interval [1, x-15]. In equation 4.17, the probability that a child of age a has k living older siblings is given by the probability that the child survives until age a, multiplied by the probability that his/her mother had parity k before the birth of the child, multiplied by the expected probability of survival of the k children. The probability that the mother had parity k before the birth of the child under consideration depends on the age of the mother at the birth of the child that we consider, and the probability of giving birth at different ages. We sum over all ages of the mother to remove the conditional probability. Finally, the survival of the siblings is related to when they were born. Since we do not have this information, we assume that those children were randomly spaced during the fertile period of the mother.

If we do not have data on parity by age, but only age-specific fertility rates, then we can think of the number of children for a woman of age x as the sum of $(x-1)$ Bernoulli trials, where for each trial the probability of success (having '1' instead of '0', or in other words having a newborn) is equal to the age-specific fertility rates for the respective age groups. Let T_s be a random variable such that:

$$T_s = \begin{cases} 1 & \text{with probability equal to the age-specific fertility rate for age } s,\ {}_1f_s \\ 0 & \text{otherwise} \end{cases}$$

Then the probability that a child of age a at time t has k living older siblings (brothers or sisters), $P(S_a(t) = k)$ is:

$$\begin{aligned} P(S_a(t) = k) &= l_a(t-a) \times \sum_{x=0}^{100} P(\sum_{s=15}^{x-1} T_s(t-a-1) = k) \times \\ &\times E[\prod_{j=1}^{k} l_{j+a}(t-a-j)] \times P(A_b = x-1, t-a-1) \end{aligned} \tag{4.18}$$

An analogous approach can be used to estimate the number of younger siblings. The formulas that I just presented can also be generalized in order to estimate the probability that at time t a child of age a has a certain number of maternal aunts or uncles who are alive. The idea behind this generalization is to consider maternal aunts and uncles as brothers and sisters of the mother and develop the formulas for siblings accordingly.

So far I have outlined an approach to estimate the extent of maternal orphanhood and kin availability through maternal lines. Critical quantities are also the probabilities of paternal orphanhood, dual orphanhood, and, more generally, kin availability through paternal lines. If we ignore the dependencies between the survivorhip of the mother and the father, then the only additional data requirement is either the age-specific fertility schedule for men or the probability that the sexual partner of a woman of age x is of age y. An approach based on fertility schedules of men is described in Grassly et al. (2005). Here I discuss a method that relies on probabilities of partnership by age.

We would like to know $P(F = y|M = x)$, the probability that the age of the father is y, given that the age of the mother is x. We can estimate this probability from sample surveys such as the DHS: we can look at households where both partners are alive and use data on their age (or age differences) to estimate the quantity $P(F = y|M = x)$. Alternatively, we can use data on the number of married people by age group and sex: these numbers for males and females can be used to form the marginals of a matrix. The single cells of the matrix can be estimated using techniques such as iterative proportional fitting (e.g., Deming and Stephan 1940). The probability that, at time t, a child of age a is alive, whereas her/his father is not, is equal to:

$$l_a(t-a) \times [1 - (\sum_{y=0}^{100} \frac{l_{y+a}(t-y-a)}{l_y(t-y-a)} \times \sum_{x=0}^{100} P(F = y|M = x) \times P(M = x, t-a))] \tag{4.19}$$

The idea behind equation 4.19 is that once we know the probability of the age of the father, given the age of the mother, then we can evaluate the probability of survival for fathers, given their age at the birth of the child.

The probability of being an orphan of both parents can be obtained by accounting for the survival probability of the mother, in addition to the one of the father. If we assume that the two probabilities are independent, then we can simply multiply them. However, it is more likely that these probabilities are positively correlated, since partners tend to be either both HIV-positive or both HIV-negative. To account for this deviation from a homogeneous population, we can use frailties in a way analogous to what I discussed for perinatal transmission in equation 4.15.

The use of correlated frailties would show that the probability of double orphanhood is higher in a heterogeneous population compared to a population where the mortality risks of parents are independent. Grassly et al. (2005) empirically evaluated the effect of correlated parental probabilities of infection on double orphanhood using cross-sectional data for sub-Saharan countries.

4.7 Conclusions

In this chapter, I discussed some insights on the process of generation of orphans that we obtain using formal demographic analysis. I compared the results from stable population theory with the ones from the population of Zimbabwe with changing demographic rates over time. From the application of the stable population theory, we see that, if the mortality and fertility rates for 2005, at the peak of AIDS deaths, persisted unchanged for a long time, then about half of the children at age 15 would be maternal orphans. Mortality conditions are expected to improve over time and we do not expect such a bleak situation to happen. However, even under fairly optimistic assumptions about the future of the epidemic in Zimbabwe, the orphanhood problem will be of crisis proportion for at least another couple of decades. This is related to the fact that there is a lag in the generation of orphans, with respect to the evolution of the HIV epidemic, and that orphanhood is a cumulative process with age. My estimates of maternal orphans are consistent with the ones produced by UNICEF, which reports that about 30% of children in the age group 12-17 are expected to be orphans in Zimbabwe in 2005 (UNICEF 2006). My analysis shows that we did not reach a peak in the orphanhood crisis in 2005. Proportion of orphans in the age group 12-17 and overall number of orphans will keep growing for several more years.

The chapter shows the relevance of macro-demographic analysis, but it also discusses its limitations when it comes to modeling key characteristics of the epidemic and evaluating changes in the whole kinship structure. Microsimulation is a more appropriate tool to evaluate kinship resources available to orphans. In the next chapter, I will describe the micro-demographic approach that I will use to evaluate the effect of the HIV/AIDS epidemic on the evolution of kinship resources available to some of the most vulnerable members of the society.

Chapter 5

Kinship resources for orphans

5.1 Introduction

In chapter two, I discussed the importance of kinship resources as a safety net for orphans in sub-Saharan Africa. In chapter three, I provided some context for Zimbabwe and I presented the available data sources. In chapter four, I analyzed maternal orphanhood with a formal demographic model which is very powerful, but limited to one sex and with no pairing between individuals to generate reproduction. In this chapter, I fully explore the effect of the HIV/AIDS epidemic on kinship resources available to orphans in Zimbabwe.

In order to assess changes in kinship structure and, in particular, the extent of double orphanhood and available kinship resources, the analytical tools that I presented in the previous chapter are not as adequate as demographic microsimulation. In the first part of this chapter, I will describe the simulation program that I used, which is known as SOCSIM. I will emphasize the modeling strategy and the modifications to the original version of the program that have been made to appropriately model the effect of the HIV/AIDS epidemic.

In the second part of the chapter, I will show my analysis of the output of the microsimulation. I will present results on paternal and grandpaternal resources for orphans. I will also assess the number of older siblings, uncles and aunts who may be available to alleviate the burden of orphanhood.

The time frame for my estimates and projections is 1980-2050. The consequences of the HIV/AIDS epidemic on generation of orphans, and availability of kinship resources, still have to fully manifest themselves. The results that I present are important to adequately address the crisis of care that will persist and, for certain aspects, deteriorate, during the next couple of decades.

5.2 The microsimulation program

5.2.1 The microsimulation core: SOCSIM

The individual-based model that I have built to perform my analysis relies on SOCSIM, a stochastic microsimulation program whose core was designed in the 1970s at the University of California, Berkeley. The infrastructure of the first version of SOCSIM was developed by Eugene Hammel and Kenneth Wachter, at the Department of Demography, UC Berkeley (e.g., Hammel, Mason and Wachter 1990). Marcia Feitel and Carl Mason are among the computer programmers who wrote the source code for the software.

SOCSIM has been used very successfully to model the dynamics of kinship structure in historical and contemporary populations (e.g., Wachter, Hammel and Laslett 1978; Wachter 1997; Wachter, Knodel and VanLandingham 1997). The core microsimulation package is very flexible and freely available to users who would like to customize it. It has been designed to model very detailed sub-groups of a population, and to address a wide range of research questions.

Each individual in the simulation is an observation in a rectangular data file, with records of demographic characteristics for the individual, and identification numbers for key kinship members. SOCSIM is efficiently written in C and takes full advantage of arrays of linked lists to keep track of kinship relationships and to store information. The simulator takes as input population files and demographic rates. It returns updated population files as output. The supervisory file

(.sup) represents the interface between the user and the source code. The user provides information to the core simulator with regards to where input files are stored, where output files are to be placed, and where demographic rates are located. In addition to that, the supervisory file contains switches for specific features, such as fertility heterogeneity and birth spacing. For each segment of the simulation, the input populations are composed of two files, one that has records for individuals (.opop) and one that has records for marriages (.omar). The demographic rates consist of fertility, mortality, marriage, and group transition rates. They can vary with the age, sex, marital status and group affiliation of the individual. If the simulation has more than one segment, which is a typical situation when demographic rates change over time, the output population for a segment can be used as input for the next one.

The individual is the unit of analysis of the simulator. Each person is subject to a set of rates, expressed as monthly probabilities of events, given certain demographic characteristics such as age, sex, marital status, etc. Every month, each individual faces the risk of a number of events including childbirth, death, marriage and migration. The selection of the event and the waiting time until the event occurs are determined stochastically, using a competing risk model. Some other constraints are included in the simulation program in order to draw events only for individuals that are eligible for the events (e.g., to allow for a minimum interval of time between births from the same mother, to avoid social taboos such as incest, etc.).

Each event for which the individual is at risk is modeled as a piecewise exponential distribution. The waiting time until each event occurs is randomly generated according to the associated demographic rates. The individual's next event is the one with the shortest waiting time. Marriage formation is a bit more sophisticated. SOCSIM is a closed simulator, in the sense that all partners must be drawn from within the existing population and cannot be externally generated. The computer program uses a two-stage process to pair eligible males and females from within the simulated population. When the next scheduled event for an individual is 'marriage', then the person is placed in a pool of eligible members to form an union. If a member of the opposite sex with appropriate demographic characteristics is available in the pool, then the two individuals are paired. Otherwise, the person stays in the pool until an appropriate mate 'picks' him/her, based on a random process with probabilities dependent on demographic characteristics of the two potential spouses.

At the end of the simulation, two main files are created, the population file and the marriage file. These files contain a list of everyone who ever lived in the population and a list of every marriage that ever occurred. From these data, it is possible to determine the main demographic characteristics of the population and the entire kin network of any individual at any time.

For more details about SOCSIM, its history, computer routines and applications, see Hammel et al. (1976), Wachter et al. (1997) and the online documentation available at www.demog.berkeley.edu/∼socsim.

5.2.2 Modelling the HIV/AIDS epidemic with SOCSIM

SOCSIM has not been specifically programmed to model the dynamics of a generalized HIV/AIDS epidemic and its demographic consequences. However, the microsimulator has been designed to be customized and modified to address a wide range of research questions. In this section, I will talk about the simulation strategy that I pursued and the modifications to the original source code that have been made to appropriately model the HIV/AIDS epidemic.

I model some of the dynamics of the HIV/AIDS epidemic by taking advantage of the flexible 'group structures' in SOCSIM. Each individual in the simulation belongs to a specific group, where the meaning of group depends on the context and the purpose of the simulation. For instance, generally speaking, groups can represent ethnicities, geographical residence, country of origin, allegiance to a soccer team or any other sort of membership. Groups are mutually exclusive: each individual can belong to only one group at a time. In the context of an HIV epidemic, I use group structures to represent HIV status. Each individual can be either HIV positive or HIV negative and is subject to mortality rates that are dependent on his/her HIV status. Adult agents in the microsimulation become HIV positive according to age-specific rates of transmission. Their life expectancy at the time they become HIV positive is modeled to be about 10 years. Newborns to HIV positive mothers can become HIV positive through perinatal transmission of the virus. This specific transmission mode of the virus is modeled through inheritance of group membership. If the mother is HIV negative at the time she gives birth, her child is born HIV negative. If the mother is HIV positive at the time she gives birth, her child is HIV positive with a probability of 0.35 at the age of one month. HIV positive children are expected to live, on average, 7 years.

For a married individual, the probability of becoming HIV positive may be associated to the HIV status of the spouse. Positive correlations in HIV status of partners increase the probability of double orphanhood, compared to a baseline scenario where the HIV status of spouses are uncorrelated. The original version of Socsim is not designed to model these correlations. The source code of the microsimulator was thus modified, in order to allow for more flexibility in this regard. In the version of Socsim that I used, the baseline age-specific risk of transition from HIV negative to HIV positive status can be multiplied by a user-defined factor, when the individual's spouse is HIV positive. The choice of the value for the multiplier is not obvious, since there is not a lot of empirical evidence in the literature on how the risk of becoming HIV positive varies according to the HIV status of the partner. There is also quite a bit of variability across countries and levels of adult HIV prevalence rates. Based on some results in the literature (e.g., Grassly, Phil and Timaeus 2005; Todd et al. 2006), I chose a value of 9 as risk factor for the simulation for Zimbabwe. This means that if an individual is HIV positive, the hazard rate of becoming HIV positive for the spouse is 9 times higher than the hazard rate of becoming HIV positive for an individual whose spouse is HIV negative.

In summary, SOCSIM has not been originally designed to model an HIV/AIDS epidemic. However, careful use of group structures and minor modifications to the core source code make it possible to model key characteristics of the HIV/AIDS epidemic, which are relevant for the process of orphans generation. In the next section, I will talk more in details about the model parameterization and the structure of the microsimulation.

5.2.3 Parameterization

In the previous section, I discussed how the simulation program has been customized in order to model the dynamics of a population affected by the HIV/AIDS epidemic. Here I introduce some key aspects of the parameterization of the microsimulation that I propose. In the next chapter, I will provide more details and I will go into the calibration procedure and statistical inference for the model.

The microsimulation for the population of Zimbabwe covers the period 1980-2050. A starting population that matches key demographic characteristics of the the actual population of Zimbabwe in 1980 has been created by letting a small unmarried initial population evolve over 100 years of time. The rates that were used for this first segment of the simulation were approximately the ones estimated for Zimbabwe in 1980, based on United Nations data sources. The initial simulated population for 1980 is composed of about 50,000 living individuals. The population size of living individuals at the end of the simulation, in 2050, is about 150,000.

The simulation is composed of 15 segments. For each segment, the computer program reads in as input a population file and demographic rates. It then produces as output a new population file. For instance, the initial simulated population for 1980, together with a set of average demographic rates for Zimbabwe for the period 1980-1984, are used as input for segment 2 of the simulation. The output for segment 2 is a simulated population file for Zimbabwe in 1985. Segment 3 of the simulation takes as input the simulated population file for 1985, together with a set of average demographic rates for Zimbabwe for the period 1985-1989, and returns a population file for 1990. The process is analogous for every segment of the simulation. With 15 segments, the last population file that is generated is the one for 2050.

For each time interval of five years, new sets of demographic rates are used as input. These rates are estimates obtained either from the United Nations estimates and projections (medium scenario), or from the Demographic and Health Surveys for Zimbabwe. Details about these data sources, and how the rates were estimated, are given in chapter three. The basic set of age-specific and sex-specific rates that are needed for the simulation are fertility, marriage and mortality rates. The baseline age-specific patterns of fertility are obtained from the 2006 Revision of the World Population Prospect (medium scenario). The baseline age-specific patterns of nuptiality come from the World Fertility and Marriage Database 2003, and the Demographic and Health Surveys. As for mortality rates, we need to distinguish between HIV positive and HIV negative individuals. For HIV negative individuals, I estimated age-specific patterns of mortality using a procedure based on cause-specific life tables derived from the 2006 Revision of the World Population Prospect (see chapter three for details). For HIV positive individuals, the pattern of mortality has been chosen to reflect a life expectancy at the time of infection of about 10 years for adults and 7 years for children. Age-specific HIV infection rates, or HIV incidence, are calculated using a back-calculation technique based on UN estimates and projections of numbers of AIDS-related deaths, and some assumptions on the progression rates from the first stage of HIV infection to AIDS and death. The approach is described in details in chapter three.

The estimated rates, which are obtained from a variety of data sources, are used as a baseline. In order to provide more flexibility to the model, and to account for the fact that there is quite a bit of uncertainty about the level of certain demographic rates, I introduced a set of parameters that rescale age-specific profiles of fertility rates, marriage rates, and transition rates from HIV negative to HIV positive status. This means that, in the simulation model, there are three rescaling parameters per segment. Given that the whole simulation is composed of 15 segments overall, the total number of parameters is 45. In the next chapter, I will talk about the estimation procedure for the parameters of interest. I will discuss more in detail the model calibration and related aspects of statistical inference for the outputs of the simulation. The focus of this chapter is on results obtained from the microsimulation. In the next sections, I will show my analysis of the evolution of kinship resources available to orphans and, more generally, children in Zimbabwe.

5.3 Kinship resources available to orphans

5.3.1 Maternal, paternal and double orphanhood

In this section, I show some estimates and projections of probabilities of maternal, paternal and double orphanhood in Zimbabwe for the period 1980-2050. Orphanhood prevalence by age and time is obtained from the analysis of the output population generated with the microsimulation program that I described in the previous sections. The results of this section complement the ones of chapter four, which mainly focused on maternal orphanhood.

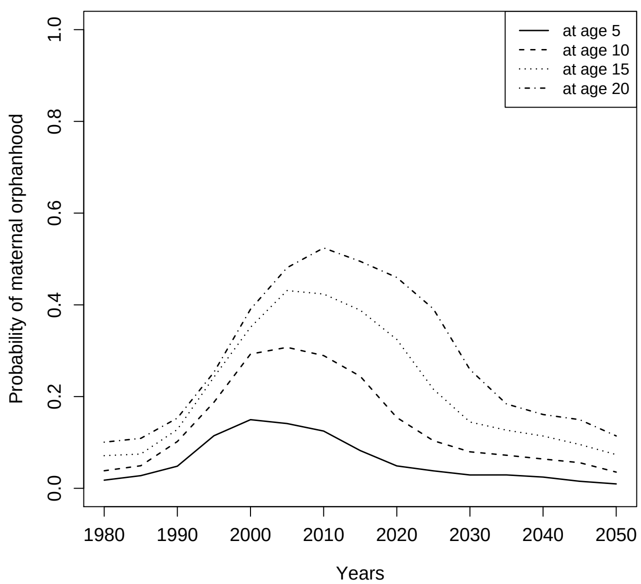

Figure 5.1: Estimated fractions of maternal orphans, by age, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

Figure 5.1 shows estimates and projections of maternal orphanhood prevalence by age, and over time. The estimated pattern is consistent with the one obtained from the macrodemographic model in chapter four. The peak in orphanhood probabilities is between 2000 and 2010, depending on age, with younger ages reaching a peak earlier in time. Maternal orphanhood prevalence decreases to pre-epidemic levels within a couple of decades from the peak. It is relevant to observe that around 40% of children at age 15 are estimated to be maternal orphans in 2010, and that in 2030 such percentage is still about 30%. Compared to the results of chapter four, which are based only on demographic rates, the estimates from the microsimulation show a faster increase in orphanhood probabilities with the onset of the HIV/AIDS epidemic, and a faster rate of reduction in orphanhood probabilities after reaching a peak. These differences are related to both the assumptions about the evolution of the HIV/AIDS epidemic over time, and the effect of perinatal transmission of the HIV virus. In the simulation, the HIV/AIDS prevalence is expected to decrease fairly quickly after reaching a peak. That is consistent with UNAIDS estimates, and would potentially generate less deaths in the adult population than the ones that we would expect under the UN medium scenario. In addition, perinatal transmission of the HIV virus leads to increased child mortality, with a peak a few years after the one in adult HIV prevalence. Perinatal transmission increases the chances of death for those children who are also more likely to be (or to become) orphans. Therefore, it is reasonable to expect that the proportion of orphans decreases at a faster rate in the microsimulation, compared to the estimates based only on demographic rates, which do not account for perinatal transmission.

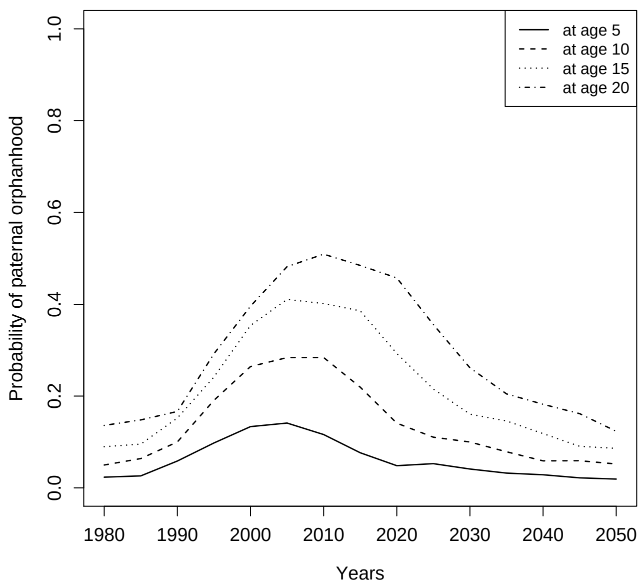

Figure 5.2: Estimated fractions of paternal orphans, by age, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

Figure 5.2 shows the evolution of paternal orphanhood probabilities over time. The results based on the microsimulation complement the ones obtained in chapter four, where I pointed out the difficulties of estimating paternal and double orphanhood within an analytical framework. The pattern or paternal orphanhood is fairly similar to the one of maternal orphanhood. Most of the survey-based estimates significantly underestimate maternal orphanhood, compared to paternal orphanhood. For the specific context of Zimbabwe, it has been shown that the discrepancies between survey-based estimates and other demographic or epidemiological models is related to problems of misreporting of foster parents as natural parents, which is especially common among mothers (Robertson et al. 2008).

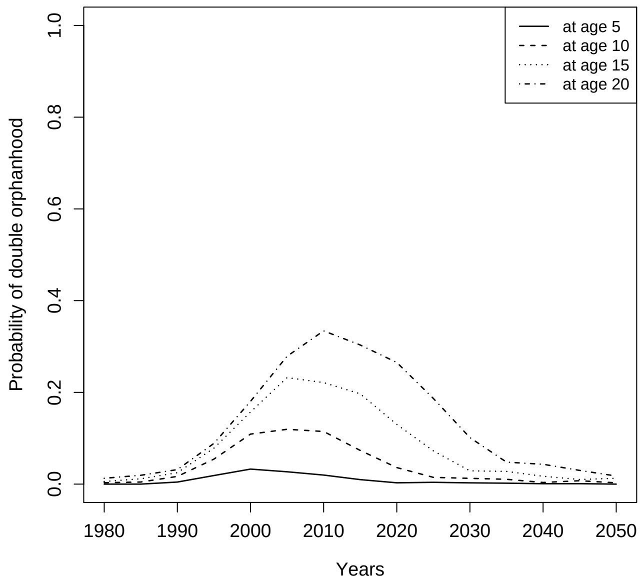

Figure 5.3: Estimated fractions of double orphans, by age, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

Figure 5.3 shows the evolution of probabilities of double orphanhood over time. The probability of having both parents dead is fairly low at age 5, but it rapidly increases with age. The probability of double orphanhood at age 10 reaches a peak at a level of around 15%. For teenagers of age 15, the peak is at about 20%. Figure 5.4 shows the estimated prevalence of double orphanhood over time for children in the age group 0-17 years old. We can observe a rapid increase in the probabilities of double orphanhood in the 1990s, with a peak around 2010 at a level of about 11%. Given the UNAIDS projections that the adult HIV prevalence rates will continue to decrease over time, the prevalence of double orphanhood will also decrease. I project the prevalence of double orphanhood to be about 6% in 2020 and 2% in 2030. Double orphanhood prevalence for 2005 is consistent with the estimates published by UNICEF (2006) which imply a prevalence in the age group 0-17 of about 11%. Projection of prevalence of double orphanhood for the future is a challenging task. As far as I know, the results of the microsimulation are the first set of projections which go beyond a 5-year horizon for Zimbabwe. These projections are novel and informative to address the lack of care.

The trend in prevalence of double orphans in Zimbabwe is of great concern. The double orphanhood condition has relevant negative consequences on the health, education and general well-being of the children who have lost their parents. The impact of double orphanhood is much more dramatic than the one of maternal or paternal orphanhood alone. A caregiver who is not a biological parent is needed for double orphans. In most cases, the caregiver who fosters the child is

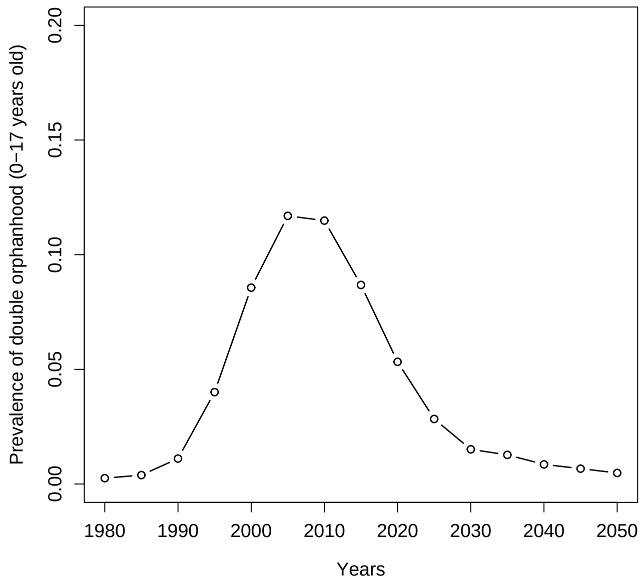

Figure 5.4: Estimated prevalence of double orphanhood in Zimbabwe for children in the age group 0-17 years old, for the period 1980-2050. Results are based on the output population file of the microsimulation.

a member of the kinship group, either a grandparent or an uncle or aunt. The HIV epidemic has a strong impact on adult mortality and reduces the pool of kinship resources available to children, at a time when the number of orphans is very high. A quantitative evaluation of kinship resources available to orphans is missing in the literature. In the next sections, I will address this important problem.

5.3.2 Grandparents

In this section, I assess the evolution over time of grandparental resources available to orphans. The young population age structure of Zimbabwe, together with the relevant demographic impact of the HIV/AIDS epidemic, generate a strong imbalance between number of orphans and availability of grandparents as potential caregivers.

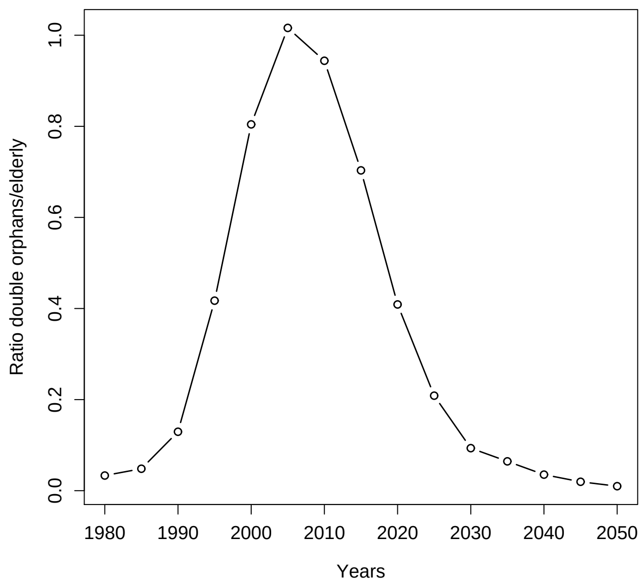

Figure 5.5: Estimated ratio of number of double orphans in the age group 0-17 years old, and number of elderly who are at least 60 years old, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

Figure 5.5 shows the estimated evolution over time of the ratio of number of double orphans in the age group 0-17 years old, and number of elderly who are at least 60 years old. The ratio is very small in the early 1980s, but it then rapidly increases in the 1990s. In 2005, the number of double orphans is about equal to the number of elderly, meaning that the burden on the elderly is very high. The ratio then slowly declines to pre-epidemic rates, as a consequence of population aging and the reduction in adult HIV prevalence rates.

The microsimulation output allows for a more detailed analysis than the one based on macrodemographic measures similar to dependency ratios. For instance, we can look at the average number of grandparents available specifically to double orphans. Figure 5.6 shows the evolution over time of this quantity for double orphans in the age group 0-17 years old. It is interesting to note that the lowest level of grandpaternal resources has yet to be reached. Based on the microsimulation results, I expect that the minimum value will be between 2020 and 2030. During

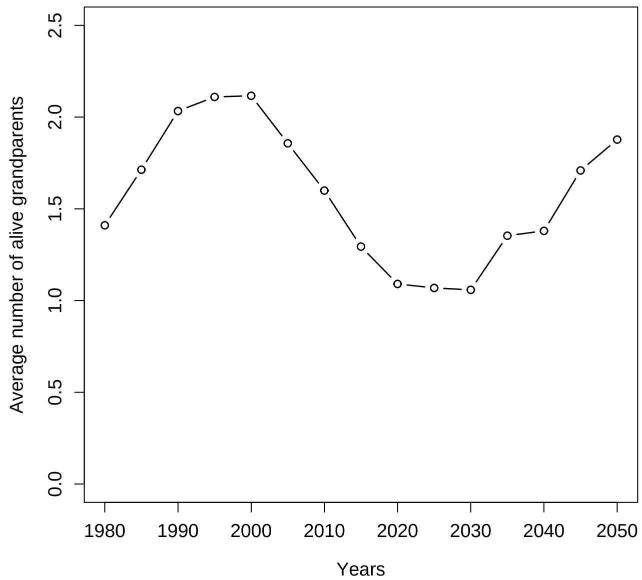

Figure 5.6: Average number of alive grandparents of double orphans 0-17 years old, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

that decade, double orphans will have, on average, only about one living grandparent to count on. Some of them will not have any grandparent at all. Figure 5.7 shows the proportion of double orphans whose grandparents are all dead. Between 2020 and 2030, we expect that about 35% of double orphans in the age group 0-17 years will not have any grandparent to rely on. These children will be particularly vulnerable. The problem of lack of care is very dramatic and needs to be addressed, especially in those situations where traditional kinship resources may not be enough. These results are therefore particularly informative for international organizations, such as UNICEF, whose mission is to protect children.

A pattern analogous to the one that I have described so far emerges also from the analysis of probabilities of living grandparents by age of the orphan. Figure 5.8 shows the Estimated fraction of living maternal grandmothers for maternal orphans, by age, for the period 1980-2050 in Zimbabwe. I chose to show maternal orphans and maternal grandmothers because losing the mother has more adverse consequences on children's health and well-being than losing the father. Maternal grandmothers have an important role as caregiver when the mother of the child dies. We observe that the probabilities of having a living maternal grandmother are at their lowest levels in the decade 2020-2030. Younger orphans tend to have a slightly higher probability of having a living grandmother than older ones, since their grandmothers are younger, on average.

This section shows the relevant impact of the HIV/AIDS epidemic on grandpaternal resources available to orphans. The most vulnerable children are double orphans with no or very little

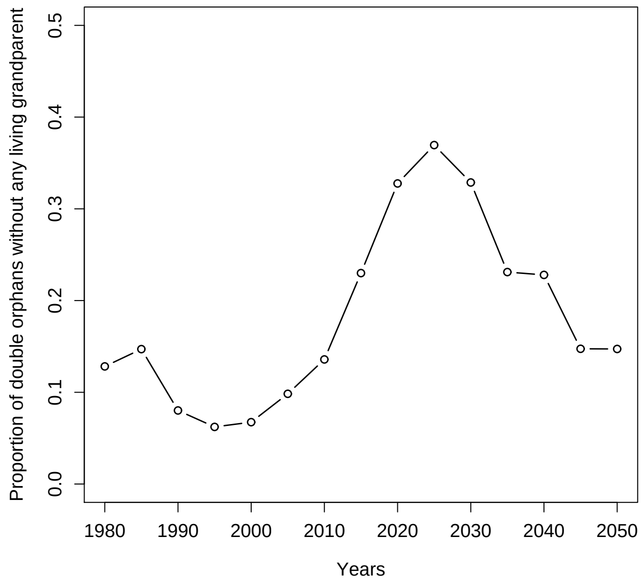

Figure 5.7: Estimated fraction of double orphans 0-17 years old whose grandparents are all dead, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

grandpaternal resources. In some cases, uncles and aunts may step in as caregivers. In other cases, other foster families, international organizations or churches may be needed. The balance between these actors depends on how traditional forms of social relationships based on mutual support will be impacted by the epidemic. That is related to the amount of kinship resources that will be eroded as a consequence of AIDS-related deaths. In the next section, I will show quantitative evaluations of the availability of uncles, aunts and siblings for orphans.

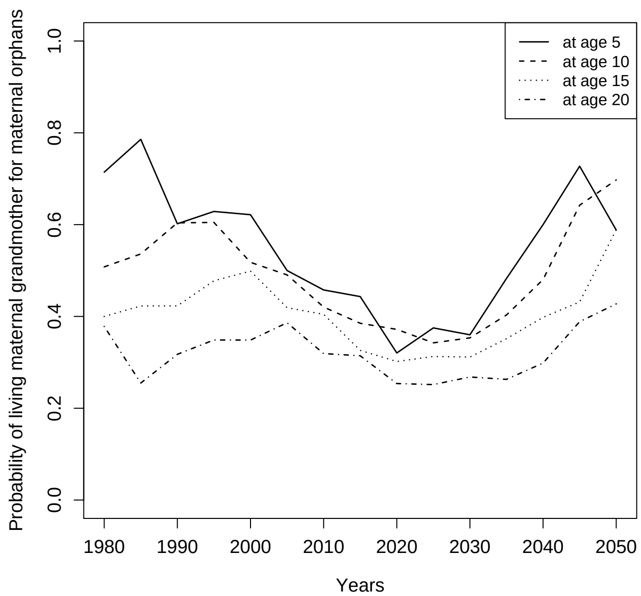

Figure 5.8: Estimated fraction of living maternal grandmothers for maternal orphans, by age, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

5.3.3 Uncles, aunts and siblings

The extended family is the traditional safety net for orphans in Zimbabwe. In this section, I will discuss the quantitative availability of uncles, aunts and siblings to orphans. In the patrilineal system of Zimbabwean communities, paternal uncles and aunts have an important role in raising children within the extended family, or in providing support to child-headed households (e.g., Foster, Makufa, Drew and Kralovec 1997).

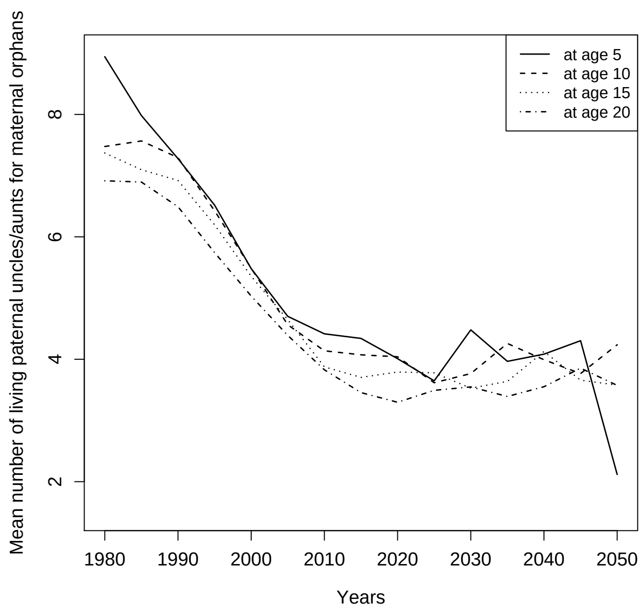

Figure 5.9: Estimated average number of living paternal uncles and aunts for a maternal orphan, by age, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

Figure 5.9 shows the estimated average number of living paternal uncles and aunts for a maternal orphan, by age, for the period 1980-2050 in Zimbabwe. Maternal orphans are more vulnerable than paternal orphans. I decided to show paternal uncles/aunts, because of their important role as caregivers in the patrilineal system of Zimbabwe. Figure 5.9 shows a progressive decline of available aunts and uncles for orphans over time. There are some differences in the number of living aunts and uncles by age of the orphan: younger children tend to have younger uncles and aunts, who are subject to a different mortality risk than older individuals. The trend over time is similar, though. It is consistent with the observation that traditional forms of social relationships are under stress, and new members of the community are providing care to children. For instance, the mechanism of mutual help between members of the same patriline is less prevalent in urban areas, where it is becoming more common for maternal aunts and uncles to take care of orphans.

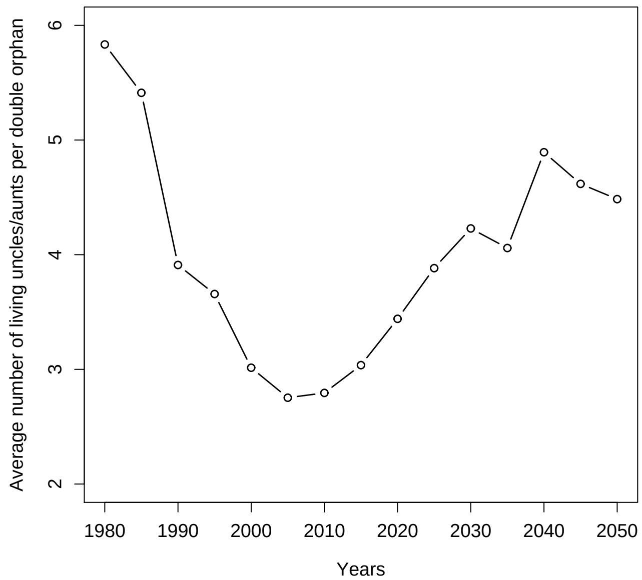

Figure 5.10: Estimated ratio of number of living uncles/aunts and number of double orphans (age group 0-17 years old) for the period 1980-2050, in Zimbabwe. Results are based on the output population file of the microsimulation.

Figure 5.9 shows one side of the story: over time, children have a smaller number of uncles and aunts to rely on. The second important aspect of the problem is the burden on each of the uncles and aunts, which is related to the number of orphans that need to be taken care of. I will focus on double orphans, who are the children who need a caregiver the most. Figure 5.10 shows the ratio of number of living uncles/aunts and number of double orphans in the age group 0-17 years old, over time. The ratio has been computed by extracting the number of unique people who are uncles/aunts to double orphans in the simulated population. Figure 5.10 shows that the burden on uncles and aunts is currently at its highest levels. In the next few decades, although orphans will continue on counting on approximately the same number of uncles/aunts, the overall number of orphans (and, more generally, children) will decrease and thus the per-capita burden on uncles and aunts will be alleviated.

Orphans are often a heavy burden on relatives, who may refuse to take care of them. Such refusal is a sign of the decline of traditional extended family practices. Foster et al. (1997) show that leading factors to the establishment of child-headed households are the death of the parents and the availability or relatives who provide support to the children, but do not accept them into their households. In other cases, relatives are nonexistent, or they are distant, sick or do not have the material means to provide for additional children. Households headed by adolescents are an additional coping mechanism in response to the impact of HIV/AIDS on communities. It is thus

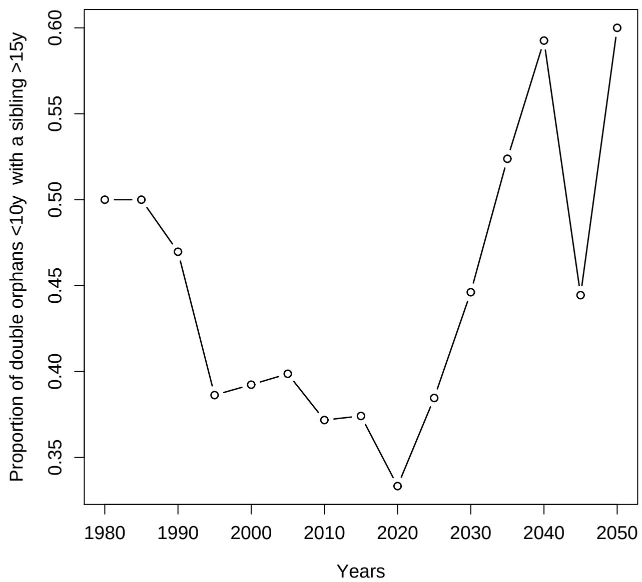

Figure 5.11: Estimated fraction of double orphans younger than 10 years old who have at least one elder sibling who is older than 15 years old, for the period 1980-2050 in Zimbabwe. Results are based on the output population file of the microsimulation.

relevant to consider the availability of elder siblings to support their younger brothers and sisters. Figure 5.12 shows the trend over time of the fraction of double orphans younger than 10 years old who have at least one elder sibling who is older than 15 years old. There is some stochasticity after 2040, mostly related to the smaller number of expected double orphans at that time. However, the trend is fairly clear. In the 1980s, before the HIV epidemic took off, half of the youngest double orphans (less than 10 years old) were expected to have at least one adolescent sibling older than 15 years old. By 2020, only about a third of the youngest orphans are expected to have a living adolescent sibling. Then the ratio is expected to increase over the course of the next decades. This result shows that, at the time when the availability of grandparents, uncles and aunts is at its lowest levels, the resources provided by elder siblings are also thin and the additional coping mechanism provided by child-headed households may be seriously undermined by the age structure of siblings.

5.3.4 An index of kinship resources

In the previous sections, I analyzed the effect of the HIV/AIDS epidemic on the generation of orphans and the availability of grandparents, uncles, aunts and siblings. In this section, I provide an index of overall kinship resources for young children.

I quantify the amount of kinship resources by weighting the availabilty of members of the same kinship group by their relatedness to the child considered. The weights are obtained using the Hamilton's coefficient of relatedness, which is defined as the percentage of genes that two individuals share by common descent. A child inherits $\frac{1}{2}$ of his/her genome from a parent. The coefficient of relatedness for a child and one of his/her parents is thus $\frac{1}{2}$. The coefficient for a child and one of his/her grandparents is $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$. The coefficient of relatedness for a child and one of his/her uncles/aunts is $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$, and so on.

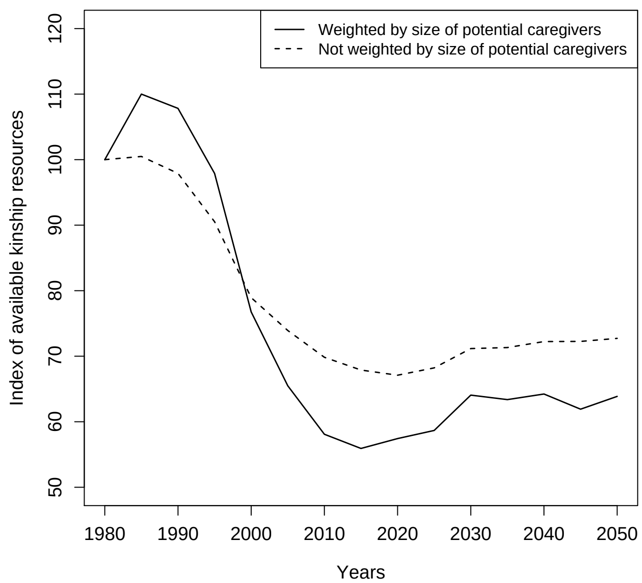

Figure 5.12: Two indexes of availability of kinship resources for children younger than 10 years old, for the period 1980-2050 in Zimbabwe. See main text for details on the indexes. Results are based on the output population file of the microsimulation.

Figure 5.12 shows two indexes of kinship resources for children younger than 10 years old in Zimbabwe, over time. The indexes are normalized so that the initial value in 1980 is equal to 100. The dashed line is the normalized average amount of kinship resources for a child less than 10 years old. For the calculation of the index, the kinship members considered are elder siblings, parents, grandparents, uncles and aunts. The members of the kinship group are weighted by their coefficient of relatedness with the child. The solid line is constructed in an analogous way, with the exception that the amount of kinship resources are also weighted by the number of unique individuals in the population that are potential caregivers. In other words, the index represented with a dashed line is multiplied by the number of unique members of the population who take up the role of siblings, parents, grandparents, uncles and aunts, to get the solid line index. The bigger the number of unique individuals, the less the average burden on each of them to take care of the children in the society.

The indexes in figure 5.12 show a transition from relatively high levels of kinship resources for children, to relatively low levels of kinship resources. The index corrected for the number of unique members of the potential caregivers group (solid line) shows a more rapid decline in kinship resources in the 1990s. Both indexes show a very slow increase in kinship resources for children after 2020.

These results open important questions on the future of traditional forms of social support based on reciprocal obligations. The demographic change associated to the HIV/AIDS epidemic, and the demographic transition, may reduce the amount of kinship resources available to children to a point that undermines the traditional role of the extended family as a safety net, and the existence of certain social mechanisms such as child fosterage.

5.4 Conclusions

In this chapter, first I described the microsimulation approach that I used to evaluate kinship resources available to children and, in particular, orphans. Then I discussed my analysis of the microsimulation output. The results that I showed complement the ones that I obtained in chapter four, where the focus was on maternal orphanhood. The microsimulation model allowed me to quantitatively analyze the evolution of kinship structure in Zimbabwe and to focus my attention on a particular category of children, double orphans, who are particularly vulnerable and, at the same time, difficult to model analytically.

I documented the evolution of kinship resources over time in Zimbabwe and I showed that, given the lag in the generation of orphans and in the erosion of kinship resources, the most adverse situation in terms of availability of caregivers and orphans still has to come. The quantitative results from the simulation have important implications for addressing the lack of care in the coming years.

The demographic change related to the HIV/AIDS epidemic and the demographic transition open important questions on the survivorship of traditional forms of social relationships that rely on the extended family as a safety net. How will the Zimbabwean society react to the rapid changes in kinship structure that the HIV/AIDS epidemic has generated? How will traditional coping mechanisms evolve in the years to come? These questions are relevant and more research needs to be done to address them.

In the next chapter, I will discuss my approach to calibrate the microsimulation model and a promising direction to make statistical inference on the quantities of interest from the output of the microsimulation.

Chapter 6

Calibration and statistical inference for the microsimulation model

6.1 Introduction

In the previous chapter, I showed the main results from the microsimulation. The emphasis of chapter five is on the analysis of the output obtained from the microsimulation. In this chapter, the focus is on the calibration of the microsimulation model and statistical inference for the quantities of interest.

In the first part of the chapter, I will introduce the problem of model calibration for simulations. In particular, I will discuss how the parameter tuning for SOCSIM has been traditionally done. Then I will present a Bayesian approach that has been developed to formalize the process of model calibration and statistical inference for simulation models. This approach has been popularized with the name of Bayesian melding by Adrian Raftery and colleagues (e.g., Poole and Raftery 2000) and it has been been adopted by the United Nations to evaluate the uncertainty in HIV prevalence projections (e.g., Alkema et al. 2007). In the last part of the chapter, I will present the approach that I used to calibrate my microsimulation model and to make statistical inference about the quantities of interest, such as orphanhood probabilities and kinship resources available to orphans.

In this chapter, I address the specific problem of calibrating the microsimulation that I used to model the effect of the HIV/AIDS epidemic on kinship structure in Zimbabwe. The chapter contributes to the more general problem of calibration of stochastic demographic microsimulation. It does not provide a definitive answer to the problem of making statistical inference for stochastic demographic microsimulation. However, it indicates and discusses directions in which the approach that I suggest can be extended and improved in order to make further progress in this important research area.

6.2 Traditional SOCSIM tuning

In principle, perfect knowledge of demographic rates should lead to an unbiased reconstruction of the kinship network through demographic microsimulation. The only uncertainty associated to the simulated kinship structure would be related to the stochasticity of the microsimulation (the use of different seeds for the microsimulator generates different random realizations).

In practice, knowledge of vital rates is far from being perfect. Kinship reconstruction and forecasting demand a level of detail for demographic rates that is often missing in available data sets. For instance, transition rates from one marital status to another one are usually not readily available and estimates may not be very accurate. Fertility rates are usually not broken down by marital status or parity, especially in the developing world. In most cases, demographic rates that are used as input to the microsimulation need to be estimated from various data sources with different sampling errors. Even when reliable data sources exist to compute demographic rates broken down by the categories of interest, the heterogeneity of the population's rates within the tabulated categories constrains the accuracy of the microsimulation.

Traditionally, the problem of calibrating SOCSIM has been addressed using *ad hoc* tuning. Input rates are adjusted on a trial and error basis in order for the output of the simulation to match key summary demographic measures obtained from a population census or sample surveys. The validity of the microsimulation has been tested by comparing kinship forecasts generated in the past with external standards provided by surveys with detailed information on numbers and ages of kin in the United States. The results of these comparisons show remarkably close agreement for some of the predictions, along with some discrepancies (Wachter et al. 1997).

The development of methods to calibrate SOCSIM has been mainly constrained by the limitation of computer power in the past. Traditional methods have heavily relied on minimizing the number of simulation runs by using expert judgement in adjusting the input demographic rates in a consistent and appropriate way.

With increasing computer power, there has been more and more interest among statisticians for the development of methods to calibrate simulations models. Bayesian methods, in particular, have proved useful to formalize the process of calibration and statistical inference. These approaches have not been developed or used for SOCSIM. However, some of the key features of these approaches can be applied to the context of demographic microsimulation. In the next section, I will present the Bayesian melding method.

6.3 Bayesian melding

The Bayesian melding is a method that has been developed mainly by Adrian Raftery and colleagues at the University of Washington (e.g., Raftery et al. 1995; Poole and Raftery 2000) to make statistical inference for simulation models. It is a Bayesian approach since it relies on the Bayesian machinery of combining prior distributions with likelihoods to obtain posterior distributions. It has been named 'melding' because it "provides a way of combining different kinds of information (qualitative or quantitative, fragmentary or extensive, based on expert knowledge or on data) about different quantities, as long as the quantities to which they relate can be linked using a deterministic model" (Poole and Raftery 2000).

I will first present the Bayesian melding in its classic application to deterministic simulation models. Then I will discuss more recent research on statistical inference for stochastic simulation models.

6.3.1 Deterministic simulation models

The main purpose of the Bayesian melding for a deterministic simulation model is to take into full account information and uncertainty about inputs and outputs of the model to make statistical inference about the quantities of interest.

Consider a deterministic simulation model, M. This model can be thought of as a function that relates a set of input variables θ to a set of output variables ϕ:

$$\phi = M(\theta) \tag{6.1}$$

The researcher translates his/her knowledge about inputs and outputs into probabilistic statements. In other words, he/she provides 'direct' prior distributions for inputs and outputs: $p(\theta)$ and $p(\phi)$.

The direct prior distribution on the inputs implicitly defines a prior distribution on the outputs. The same way, if the model M is invertible, the direct prior distribution on the outputs implicitly defines a prior distribution on the inputs. These implicitly defined priors are given the name of 'induced' prior distributions: $p^*(\theta)$ and $p^*(\phi)$.

The two sets of priors, direct and induced, are combined through logarithmic pooling to form the 'pooled' prior distributions:

$$\tilde{p}(\theta) = p^*(\theta)^\alpha p(\theta)^{1-\alpha} \tag{6.2}$$

$$\tilde{p}(\phi) = p^*(\phi)^\alpha p(\phi)^{1-\alpha} \tag{6.3}$$

The posterior distributions for the parameters of the model, inputs and outputs, are then obtained by combining pooled priors and likelihoods, using the Bayes theorem:

$$p(\theta|Data) \propto \tilde{p}(\theta)p(Data|\theta) \tag{6.4}$$

$$p(\phi|Data) \propto \tilde{p}(\phi)p(Data|\phi) \tag{6.5}$$

When it is not possible to write an analytical representation of the posterior distribution, then an approximation of the distribution is obtained computationally using algorithms such as the sampling-importance-resampling (Rubin 1987, 1988), incremental mixture importance sampling (Raftery and Bao 2009), or Markov Chain Monte Carlo methods.

In addition to providing priors for inputs and outputs, the researcher brings extra information to the inference process in two additional ways. First, the choice of the parameter α for the logarithmic pooling is essentially arbitrary. With $\alpha = 0.5$, the logarithmic pooling amounts to taking the geometric mean of the two prior densities. Poole and Raftery (2000) discuss some strategies for the choice of α.

The second situation when extra information is needed is when the model M is not invertible. In that case the pooled prior distribution of the model outputs is still unambiguously defined, but the one of the model inputs is not, since more than one set of inputs is mapped into the same set of outputs. To solve this problem, Poole and Raftery (2000) suggested an approach which is based on the reasoning that prior information about the outputs does not give any information about the relative probability of one set of inputs, with respect to other sets of inputs which map onto the same set of outputs. However, the probability for all sets of inputs which map onto one set of outputs, and the pooled probability for the specific set of outputs, have to be equal. Poole and Raftery (2000) proposed to split this probability among the possible sets of inputs which map onto the specific set of outputs, proportionally to their prior 'direct' density distribution.

Since the seminal work of Raftery and colleagues (Raftery et al. 1995; Poole and Raftery 2000), the Bayesian melding method has been applied to deterministic simulation models in several different fields. In the context of the HIV/AIDS epidemic, the Bayesian melding has been successfully used to assess the uncertainty in estimates and projections of HIV prevalence rates produced using the United Nations Estimation and Projection Package (e.g, Alkema et al. 2007; Raftery and Bao 2009).

6.3.2 Stochastic simulation models

The Bayesian melding method has been proposed to make statistical inference for the quantities of interest of deterministic simulation models. With the growing importance of agentbased models and stochastic microsimulations, there has been an increasing interest for extensions of the Bayesian melding.

Statistical inference for individual-level stochastic simulations is a new and active area of research. A consistent and fully developed body of literature has not formed yet. In this section, I present an approach that has been proposed to assess uncertainty in urban simulations (Sevcikova, Raftery and Waddell 2007). The goal of the method is similar to the one of the Bayesian melding: the combination of all available evidence about model inputs and model outputs in a coherent way. The main idea is that statistical inference can be easily made for the input parameters of the model, by obtaining the posterior distribution of the inputs. The combination of this posterior distribution and the randomness associated to the use of different seeds for the microsimulation provides a measure of uncertainty in the quantities of interest, which are functions of the outputs.

The first step is to express the available information about inputs and outputs in terms of probability distributions. For instance, this can be done by providing a prior distribution on the inputs $p(\theta)$. Then the researcher has to specify a conditional probability distribution of the data given the outputs ϕ.This yields a likelihood for the outputs:

$$L(\phi) = p(Data|\phi) \tag{6.6}$$

It also yields a likelihood for the inputs, because $\phi = M(\theta)$:

$$L(\theta) = p(Data|M(\theta)) \tag{6.7}$$

From the Bayes's rule, the combination of the prior on the inputs, $p(\theta)$, and the likelihood, $L(\theta)$, gives the posterior distribution:

$$p(\theta|Data) \propto p(\theta)L(\theta) \tag{6.8}$$

In order to obtain the posterior distribution for the quantities of interest, Sevcikova et al. (2007) suggested a computational approach that is based on the sampling importance resampling (SIR) algorithm of Rubin (1987, 1988). Here are the main steps:

1. Draw a sample $\{\theta_1, \cdots, \theta_I\}$ of values of the inputs from the prior distribution $p(\theta)$;
2. For each θ_i, run the model J times with different seeds to obtain ϕ_{ij}, $j = 1, \ldots, J$;
3. Compute the weights $w_{ij} = L(\phi_{ij})$ and obtain an approximate posterior distribution of the inputs with values $\{\theta_1, \cdots, \theta_I\}$, and probabilities proportional to $\{\bar{w_i} : i = 1, \ldots, I\}$, where $\bar{w_i} = \frac{1}{J}\sum_{j=1}^{J} w_{ij}$.
4. The approximate posterior distribution of the outputs has $I \times J$ values ϕ_{ij}, with weights w_{ij}.

The method is fairly general. The researcher has to choose a parameterization for the output of his/her model, in order to compute the likelihood function. Sevcikova et al. (2007), for instance, used a model based on the normal distribution.

As I indicated at the beginning of this section, there is no definite answer to the problem of statistical inference for the quantities of interest of stochastic individual-based models. In this section, I presented a method that recently appeared in the literature and that strongly influenced my approach to calibration and statistical inference for demographic microsimulation. In the next sections, I will present and discuss the methodology that I used for my simulation model of the effect of the HIV/AIDS epidemic on orphanhood probabilities and kinship structure.

6.4 Calibration of the microsimulation model

In this section, I discuss the method that I propose to calibrate the microsimulation, whose results I showed in the previous chapter. First, I describe the general idea behind the calibration process. Then I provide the details of the approach. Finally, I show some consistency checks on the outcomes of the calibration.

6.4.1 The general idea

Figure 6.1 shows a schematic representation of the approach that I used to calibrate the microsimulation model. In this section, I describe the approach in a simplified and non-technical way. In the next section, I will provide more details.

The microsimulator requires demographic rates as input, and generates population files as output. The population files can then be analyzed, and summary statistics such as total fertility rates, proportion of individuals younger than 25, etc., can be extracted. These quantities can be compared with the respective summary statistics obtained from sample surveys or population censuses. In addition, other quantities of interest, which may not be readily extracted from sample surveys or censuses, can be estimated from the output population files.

We do not know the input rates with certainty. The goal of the calibration process is thus to find a set of input rates which are associated to simulated populations whose key characteristics closely match the ones extracted from sample surveys or population censuses. We may rescale some age-specific demographic input rates using a set of parameters θ. We express our uncertainty about the rescaling parameters using a probability distribution on the parameters; that is the prior distribution. The choice of a particular set of parameters from the prior distribution yields a population output for which we can compute the likelihood, based on a comparison with sample survey results. The combination of the prior distribution and the likelihood gives the posterior distribution for the rescaling parameters. The posterior means for the parameters of interest are the final choice for the rescaling parameters.

6.4.2 The calibration process

In the microsimulation that I ran, several sets of rates are used as input to the model (e.g., age-specific fertility rates, age-specific marriage rates, age-specific transit rates from HIV-negative status to HIV-positive status, HIV-status and age-specific mortality rates, etc.). The simulation is composed of 15 segments and covers the period 1980-2050. For each segment, which spans a period of time of five years, there is an associated set of input rates and an output population file. The input rates are estimated using data from the Demographic and Health Surveys and United Nations estimates and projections.

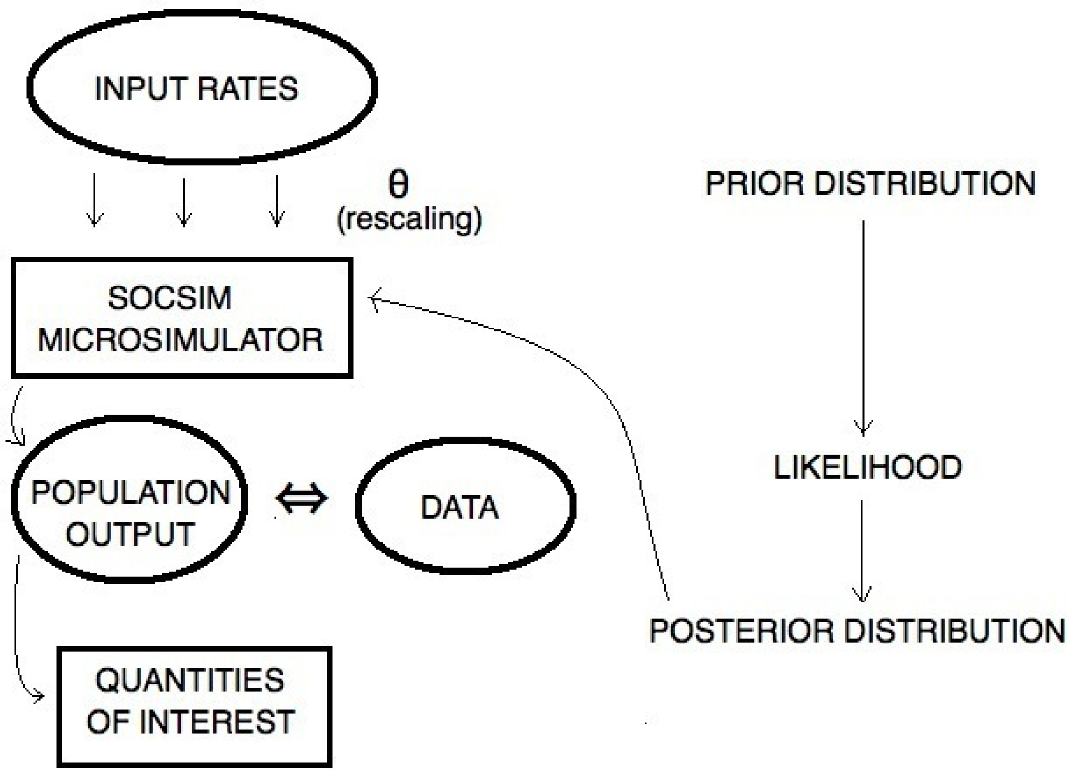

Figure 6.1: A schematic representation of the approach that I used to calibrate the microsimulation model for the evaluation of the effect of the HIV/AIDS epidemic on kinship structure in Zimbabwe.

We do not know the demographic rates with accuracy. I assumed that the shape of the estimated age-specific rates is fairly accurate and thus most of the uncertainty is associated to the scale or level of the parameters. Based on this premise, I chose a set of three parameters for each segment that rescales age-specific fertility rates, marriage rates and transit rates from HIV negative to HIV positive status. I refer to the triplet of parameters for segment i as θ_i, with $\{i = 1, \ldots, 15\}$.

For each θ_i, I express my uncertainty by providing a prior distribution. The main purpose of the prior, for my application, is to define upper and lower bounds that are consistent with UN and DHS data sources. I chose the the prior on the rescaling parameters to be uniform, typically between 0.1 and 3.

For the first set of rescaling parameters, θ_1, the likelihood for a specific combination of three rescaling parameters is computed as follows:

1. Run SOCSIM n times, with the same set of chosen parameters, but different seeds, and store the outputs.

2. From the n simulation outputs, compute the mean vector μ and the variance-covariance matrix Σ for a set of five key summary quantities: total fertility rate, proportion of population younger than 25, proportion of males younger than 25 who are married, proportion of women younger than 25 who are married, HIV prevalence rate.

3. Based on a normal approximation, the probability of observing the UN estimates (medium scenario) for the key summary quantities, x, given the chosen set of parameters is:

$$f_X(x) = \frac{1}{(2\pi)^{5/2}|\Sigma|^{1/2}} exp(-\frac{1}{2}(x-\mu)'\Sigma^{-1}(x-\mu)) \tag{6.9}$$

   This is the likelihood of the specific set of parameters, that is the probability of observing the data (UN or DHS), given the chosen parameters.

For the set of rescaling parameters other than the first one, the approach is analogous, with the only difference being that SOCSIM is run with mean posterior estimates of the rescaling parameters for the segments that come before the segment of interest.

Given a prior distribution and a parameterization to compute the likelihood, the posterior distribution for the rescaling parameters is obtained using the SIR algorithm (Rubin 1987, 1988):

1. Sample with replacement a number m of parameter vectors from the prior distribution.

2. For each sampled vector, compute the sampling importance weight, which is proportional to the likelihood for the sampled vector.

3. Sample with replacement from the m parameter vectors with probabilities proportional to the weights to approximate the posterior distribution.

An obvious choice for the parameters is the mean of the posterior distribution. In practice, some further minor adjustments are needed in order to smooth the key summary statistics for the simulated population over time.

6.4.3 Consistency checks

In this section, I show some consistency checks for the outcomes of the calibrated microsimulation. I compare some key summary quantities for the simulated population and the medium scenario of the United Nations 2006 Revision of the World Population Prospects. In particular, figures 6.2 through 6.11 provide a graphical representation of both simulated and United Nations estimates and projections for total fertility rates, adult HIV prevalence rates, population age structure and age-specific mortality rates.

The simulated populations closely match the United Nations estimates and projections for total fertility rate and population age structure. The trend in adult HIV prevalence is similar for the simulation and UNAIDS/WHO (2008) estimates. However, the reduction in adult HIV prevalence rates after the peak in 2000 is slower in the simulation than in the estimates of UNAIDS/WHO (2008). Age-specific mortality rates from the simulated population show a trend similar to the one

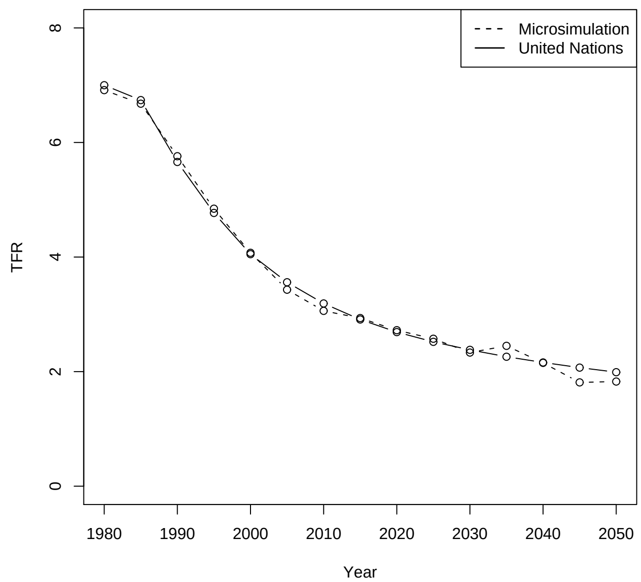

Figure 6.2: Estimates and projections of total fertility rates (TFR), for the period 1980-2050 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

of the United Nations. But there are some discrepancies. The adult mortality in the simulated population is consistently higher than the United Nations medium scenario for the 1990s and consistently lower than the United Nations medium scenario projections for the period 2030-2050.

Overall, the calibrated model captures key characteristics of the HIV epidemic fairly well, especially given the rather parsimonious parameterization. One of the reasons for the observed discrepancies may be related to the fact that the demographic rates used for the calibration come from different data sources which may not necessarily be consistent.

A second reason may be related to the fact that the calibration focuses on matching only a subset of all the possible summary statistics. This parsimonious choice is dictated by the extremely large computing time required by the calibration procedure. I ran SOCSIM on state of the art machines of the Berkeley Demography Computer Lab (e.g., Dual-Core AMD Opteron Processor 2216 HE, with speed of 1000Mhz, and a total of 16GB of RAM). The computing time required to calibrate the model with the current parameterization is in the order of three days. Using a larger number of parameters, without developing more efficient algorithms, would rapidly increase the computing time beyond a reasonable level.

A third reason behind the observed discrepancies is that the calibration procedure relies on single observations for projections of key quantities in the future. For example, it relies on only one value of the TFR published by the UN for each year in the projection period. Little is known

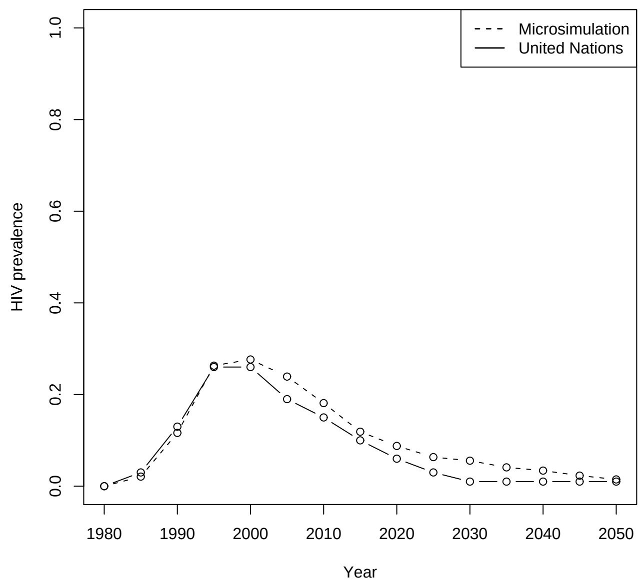

Figure 6.3: Estimates and projections of adult HIV prevalence rate, for the period 1980-2050 in Zimbabwe, from the simulated population and UNAIDS/WHO (2008).

about the uncertainty in the UN projections. This is another important limitation of the calibration process. In the conclusions of this chapter I will provide some discussion about the strengths and limitations of the approach, together with potentially fruitful directions for research in this area.

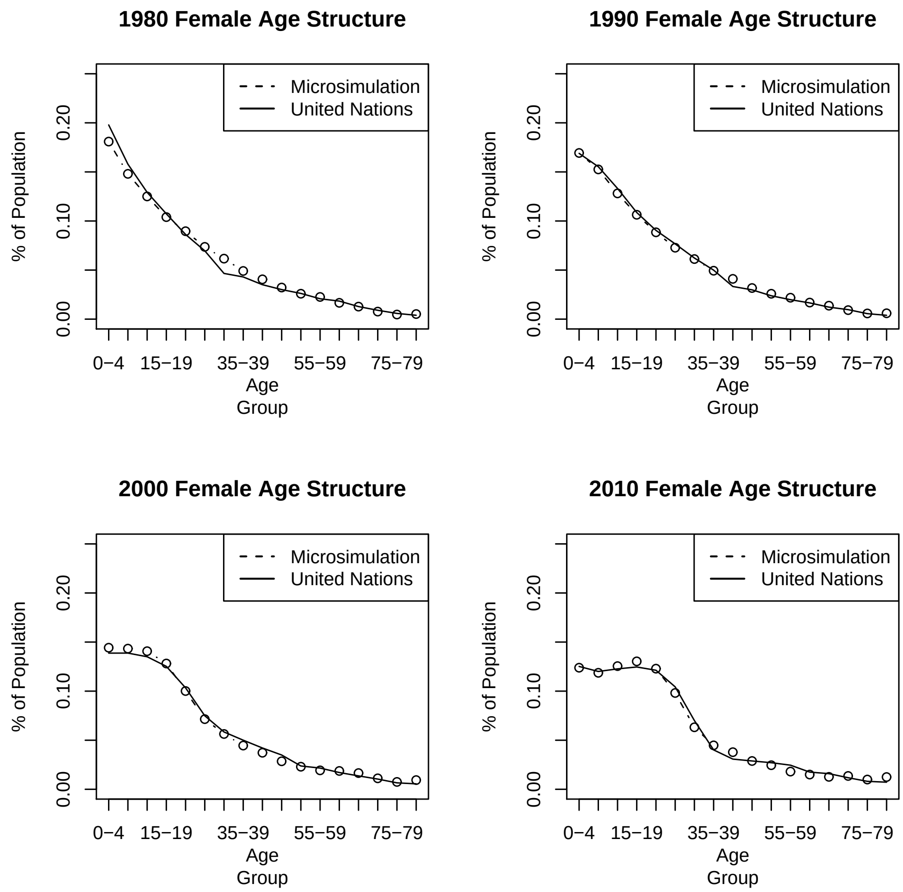

Figure 6.4: Estimates and projections of female population age structure, for the period 1980-2010 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

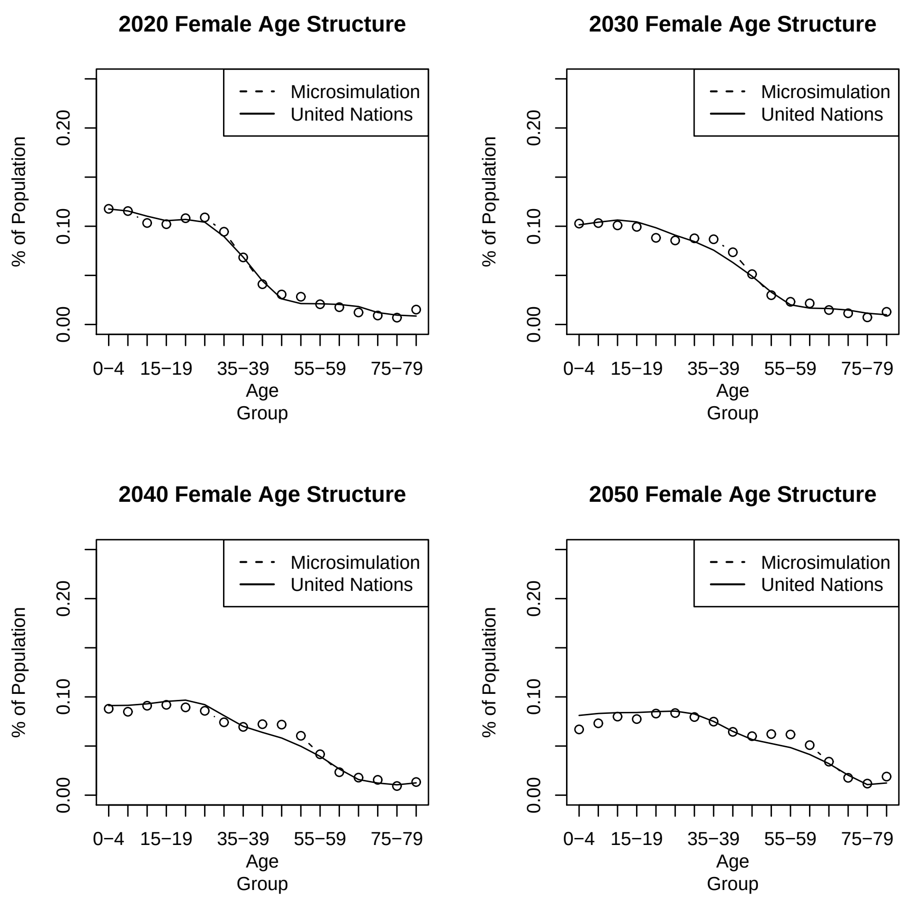

Figure 6.5: Estimates and projections of female population age structure, for the period 2020-2050 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

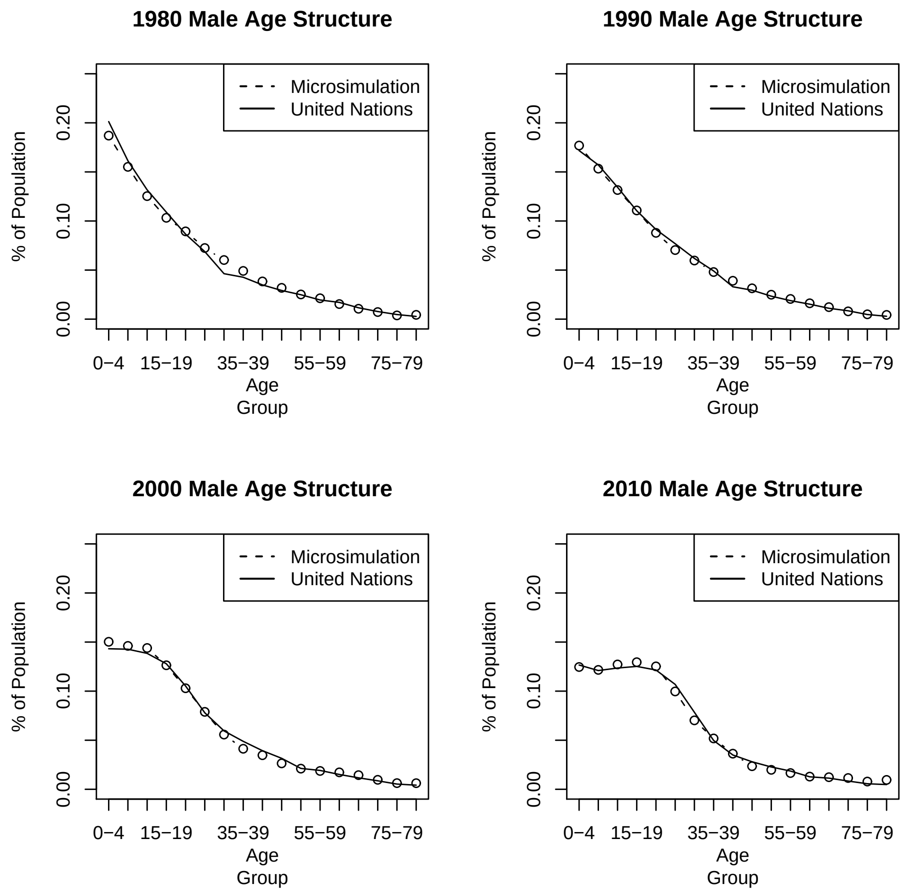

Figure 6.6: Estimates and projections of male population age structure, for the period 1980-2010 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

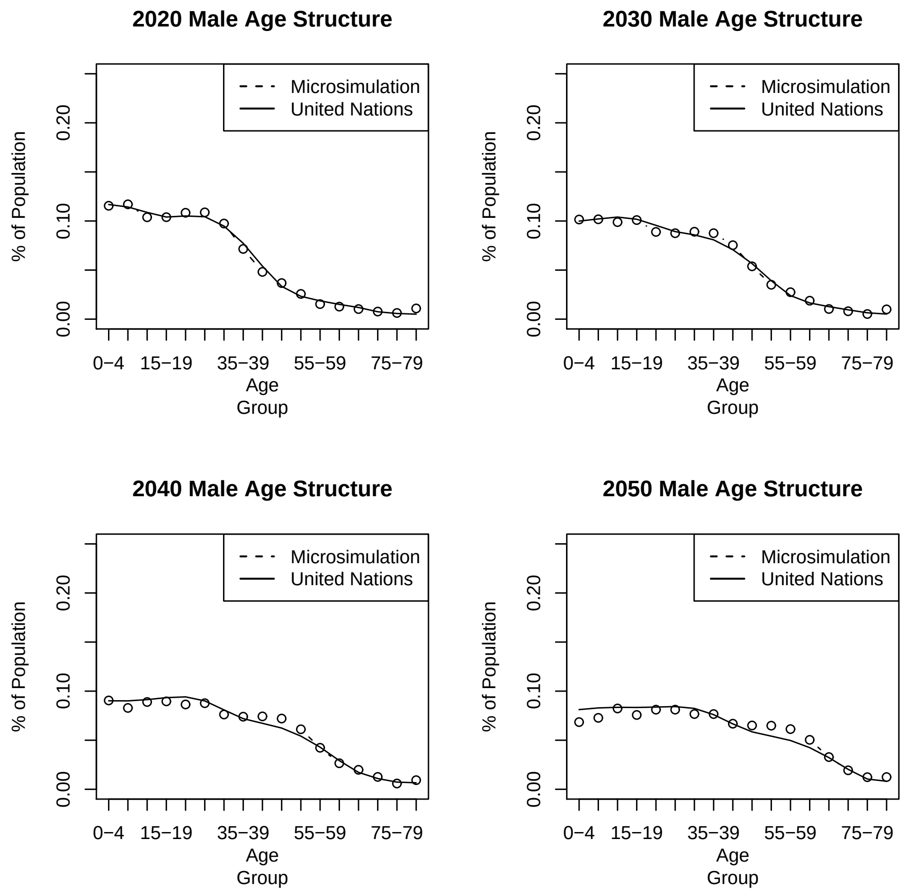

Figure 6.7: Estimates and projections of male population age structure, for the period 2020-2050 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

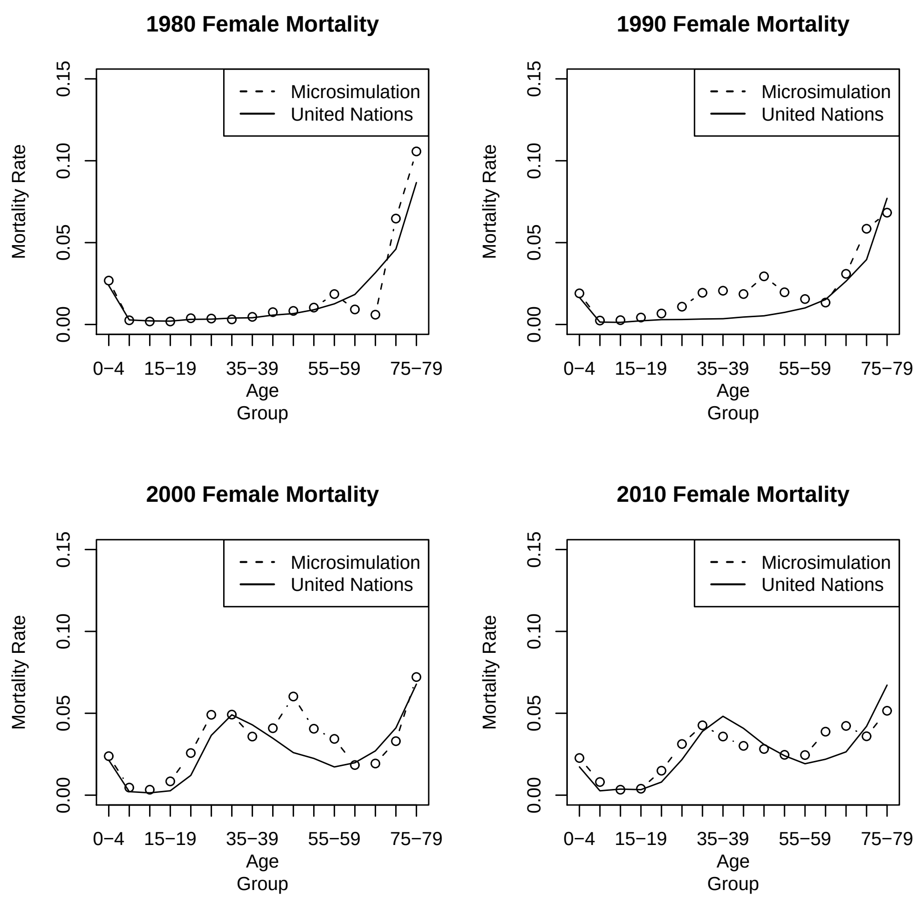

Figure 6.8: Estimates and projections of age-specific female mortality rates, for the period 1980-2010 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

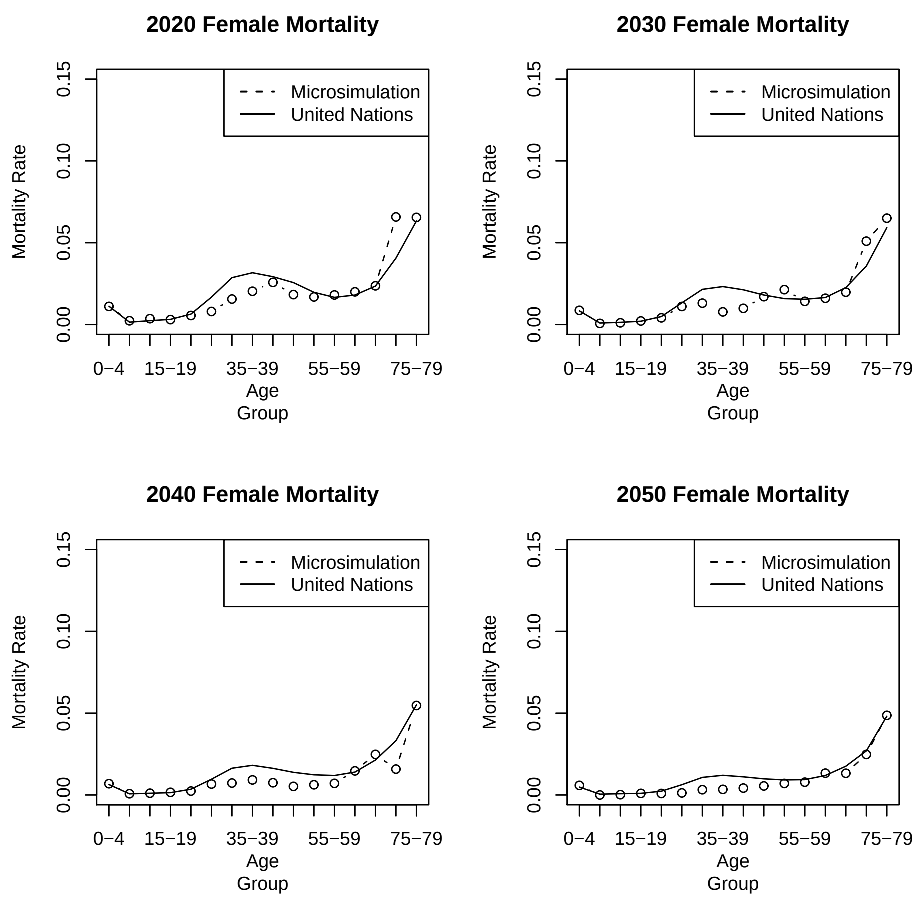

Figure 6.9: Estimates and projections of age-specific female mortality rates, for the period 2020-2050 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

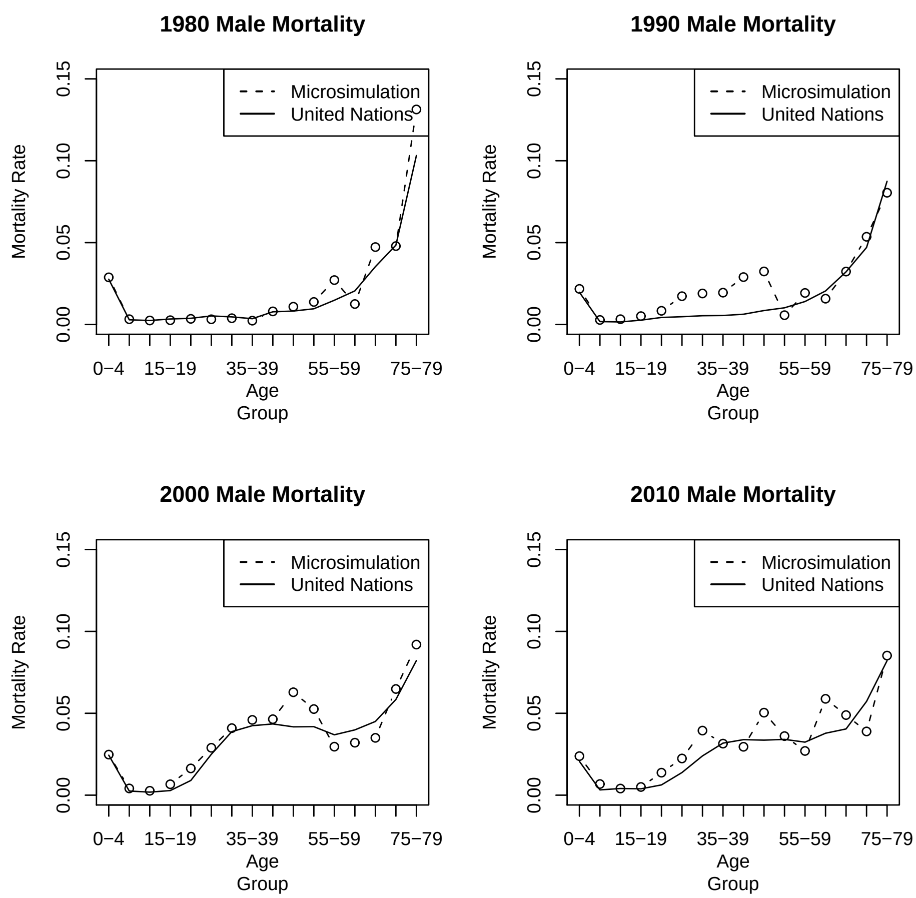

Figure 6.10: Estimates and projections of age-specific male mortality rates, for the period 1980-2010 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

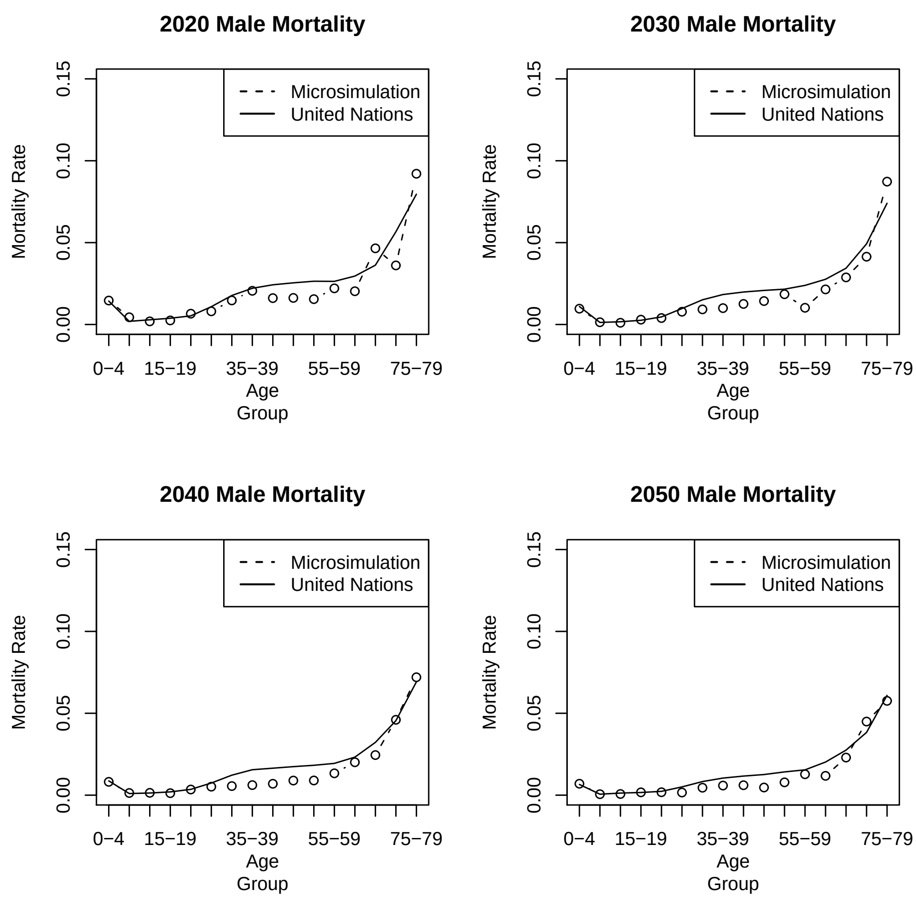

Figure 6.11: Estimates and projections of age-specific male mortality rates, for the period 2020-2050 in Zimbabwe, from the simulated population and the United Nations 2006 Revision of the World Population Prospects (medium scenario).

6.5 Statistical inference for the quantities of interest

Once the posterior distribution for the rescaling parameters θ_i, $\{i = 1, \ldots, 15\}$, is obtained, then it is possible to make statistical inference for the quantities of interest. The idea is that we can randomly draw from the posterior distribution of the rescaling parameters to generate a large number of simulation runs and associated realizations.

Figure 6.12 shows an illustrative example of 100 realizations of probabilities of paternal orphanhood at age 15, over time. Each realization is obtained from running the microsimulation with rescaling parameters sampled from the posterior distributions. The spread in the outcomes reflects the uncertainty about the rescaling parameters and the stochasticity of the microsimulation.

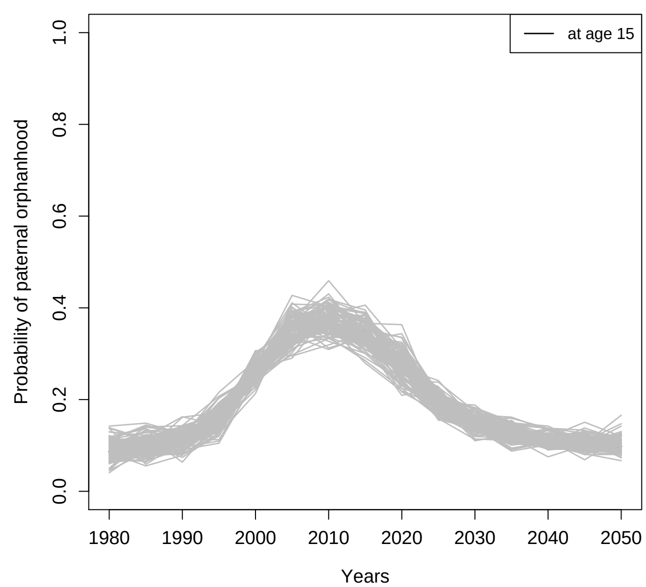

Figure 6.12: Illustrative example of estimated model uncertainty for the prevalence of paternal orphanhood at age 15, for the period 1980-2050 in Zimbabwe.

There is one important element of uncertainty that is not accounted for in this analysis, due to the nature of the data. The calibration process relies on point estimates for key quantities projected by the United Nations (medium scenario). For these quantities, we do not have any stochastic forecast or confidence interval. We only have point estimates based on projections and scenarios. I treat the data points from the medium scenario as if they were the true values for the quantities of interest. In truth, there is uncertainty about the estimates for the present and the past. For the projections for the future, the farther we project into the future, the more uncertainty there is. Figure 6.12 does not account for this uncertainty. If this uncertainty were taken into consideration, then we would observe an increasing spread of outcomes over time for the projections in the future.

In this section, I showed that the posterior distribution for the rescaling parameters can be used to evaluate the microsimulation uncertainty for the quantities of interest. Given that we do not have a probabilistic measure of the uncertainty associated to United Nations estimates and projections, there is not a clear way to assess the growing spread of outcomes over time. Since the analysis is based on United Nations estimates and projections, it is possible to mimic the United Nations scenario approach. Figure 6.12, for instance, shows the uncertainty in the probabilities of paternal orphanhood at age 15, associated to the demographic rates for the United Nations medium scenario. We could use the same approach for the whole sets of scenarios from the United Nations, to get a sense of the overall spread of the quantity of interest, across scenarios.

The evaluation of the uncertainty for the outputs of microsimulation models is important. In this section, I provided an example for illustrative purposes. The example is relevant for the general field of kinship forecasting. In those contexts where the available data allow for probabilistic projections of demographic rates, such as the United States, the methodology would produce stochastic forecasts of kinship structure. My research is moving in that direction.

6.6 Conclusions

In this chapter, I introduced the problem of calibration and statistical inference for demographic microsimulations. First, I described the traditional SOCSIM tuning. Then, I summarized the literature on the Bayesian melding method for statistical inference for simulation models. Finally, I proposed a 'Bayesian tuning' approach to calibrate my microsimulation model and to assess some components of uncertainty. The Bayesian approach that I suggested formalizes the calibration process that demographers have always done informally for microsimulations. Typically, the researcher starts with some estimate of input rates, then he/she checks the outcomes to assess the consistency between the simulation output and external data sources. Then he/she goes back to tweak the input rates and repeats the whole procedure until the simulation output and the external data sources match in a satisfactory way.

The calibration method that I proposed is an integral part of the microsimulation model. It is important for my specific application and it is also relevant for the general field of kinship forecasting and demographic microsimulation.

The approach that I suggested does not provide a definite answer to the problem of calibration and statistical inference for demographic microsimulations. Instead, it is the first step towards a more comprehensive methodology. I think that the most relevant areas of future research concern parameterization, algorithm efficiency, and full assessment of uncertainty.

In the model that I proposed, the parameters rescale the estimates of input rates. Such parameterization relies on the assumption that the shape of age-specific demographic rates is fairly accurate, but the level is not known with certainty. The parameterization of the model can be improved by allowing the shape of age-specific profiles to be dependent on a parameter. This could be done using some sort of model life tables such as the Brass relational model (Brass 1974) or a parameterization in the fashion of the Lee-Carter method (Lee and Carter 1992). Some sensitivity analysis may also reveal the best choice for the number of parameters that should be used, and which sets of rates should be parameterized.

Research on algorithms to approximate posterior distributions is essential for the application of computational techniques. Bayesian approaches to calibration and statistical inference for simulation models would not have developed without the increasing computing power over the past few decades. However, computer power can still be a limiting factor when the parameterization becomes fairly large and when the profile of the likelihood is particularly irregular, with ridges and local peaks. For instance, the calibration procedure for the microsimulation model that I presented required computing time in the order of three days. Improvements of the algorithms to evaluate the profile of the likelihood function may drastically reduce the current need for additional computer power.

Finally, in this chapter I presented a way of evaluating the uncertainty related to a scenario for the quantities of interest. As I discussed in the previous section, that is the first step towards a more comprehensive assessment of uncertainty. For the specific application of my dissertation, the main limiting factor is the unavailability of quantitative information about the uncertainty of key demographic characteristics of the population under study over time.

Chapter 7

Conclusion

With this chapter, I conclude the dissertation on the the impact of the HIV/AIDS epidemic on orphanhood probabilities and kinship structure in Zimbabwe. I summarize the main results of the study. Then I discuss the relevance of the findings and the limitations of my approach. Finally, I propose some avenues of research for the future.

7.1 Summary of main results

This study provides a quantitative assessment of the material basis of traditional kin relations in Zimbabwe. I used data obtained from the Zimbabwe Demographic and Health Surveys, and United Nations estimates and forecasts, to inform a formal demographic model and a microsimulation.

The focus of the formal demographic model is on maternal orphanhood. One of the main results is that the number of maternal orphans in Zimbabwe, in the age group 0-17 years, is expected not to decline until around 2030. This is related to the fact that the transition to orphanhood is a cumulative process with age, and that there is a lag between the peak in adult HIV prevalence and the one in AIDS-related orphanhood prevalence. The probability of maternal orphanhood at age five is estimated to reach a peak between 2000 and 2010. At age 17, the peak is expected to be between 2010 and 2020.

The microsimulation complements the formal demographic analysis with a more sophisticated model. The population outputs of the simulation are used to estimate quantities for which analytical expressions are cumbersome and do not provide particularly interesting insights. For example, the microsimulation is useful to evaluate the trend in kinship resources for double orphans. The proportion of double orphans without any living grandparent is expected to increase until about 2030. Then it will decrease. This trend will shift the responsibility for double orphans to uncles and aunts. On average, the number of uncles and aunts per double orphan has been decreasing from 1980 to 2010, but it is expected to increase progressively during the next decades. Overall, I estimate a transition, between 1990 and 2010, from fairly high to fairly low levels of kinship resources for young children in Zimbabwe.

In addition to substantive results, the contribution of the dissertation is also methodological. Traditional forms of parameter tuning for demographic microsimulations are formalized within a Bayesian framework. The study does not provide a definite answer to the problem of model calibration and statistical inference for the outputs of demographic microsimulations. However, it gives a contribution towards the development of a more comprehensive methodology to assess uncertainty in the field of stochastic kinship forecasting.

7.2 Relevance of the findings

The extended family has been recognized as an important safety net in sub-Saharan Africa. With the onset of the HIV/AIDS epidemic, there has been an increasingly stronger demographic pressure on social forms of relationships based on reciprocal obligations among members of the same kin group. Two broad questions then arise in this context. First, how much kinship resources will be available to the most vulnerable members of the society, in particular young orphans? Second, is there a future for traditional social practices, such as purposive child fosterage, which are mainly based on mutual support among members of the same kin group?

Answering the first question is important to address the lack of care for orphans. Given the relevance of the extended family for coping mechanisms, it is crucial to estimate kinship resources available to orphans for planning purposes. Estimates and projections of kinship structure are not generated and published by international agencies. Such quantities would complement statistics on number of orphans and prevalence of orphanhood. My dissertation highlights the importance of kinship resources to cope with the dramatic impact of the HIV/AIDS epidemic in Zimbabwe. The study is a call for the development of kinship forecasting for sub-Saharan Africa. Forecasts of kinship resources available to orphans would be useful for policy makers when they plan interventions to mitigate the impact of HIV/AIDS on children.

The second question has broad implications for sociological research. Will traditional forms of social relationships survive the impact of the HIV/AIDS epidemic? My theory is that demographic pressure may become strong enough to make some traditional practices, such as purposive fosterage, unfeasible. An extended period of 'emergency' fosterage practices, together with a reduction in the average size of kinship groups, may undermine the basis for the existence of traditional forms of social obligations based on reciprocal advantages. New forms of social relationships and living arrangements may emerge in order to spread risks across kinship groups. I showed that during the next couple of decades demographic pressure on traditional forms of social relationships may continue to be strong. The next couple of decades will thus be crucial for the sustainability of practices such as fosterage. My results provide quantitative estimates of kinship resources for orphans in Zimbabwe. The way in which traditional relationships evolve, in relation to demographic trends, can be further investigated by either monitoring Zimbabwe over time, or by looking at countries that are differentially affected by the HIV/AIDS epidemic.

7.3 Limitations of the study

The two main tools that I used in this dissertation, namely formal demographic analysis and microsimulation, are very powerful, but they are also subject to relevant limitations. In this section, I discuss the major drawbacks of my analysis.

The formal demographic analysis that I presented relies only on demographic rates. It thus fails to account for the epidemiological aspects of the HIV/AIDS epidemic. As a result, the formal demographic model tends to overestimate orphanhood prevalence, since it does not account for factors such as mother-to-child HIV transmission, and, more generally, for the positive correlations in the risk of mortality of mothers and their children. An extension of the model to incorporate epidemiological parameters is certainly feasible. However, for this dissertation, I preferred to use formal demographic analysis to emphasize the insights on the demographic process of orphans' generation. Moreover, the limited data requirements for the method make the approach appealing for comparative purposes.

Microsimulation allows for large flexibility in modeling strategies. Epidemiological parameters were easily incorporated in the model. However, the higher degree of complexity is also associated to increased difficulties with parameterization, especially in the context of sub-Saharan Africa, where accurate demographic and epidemiological data may not be available. Simple parameterizations may underplay the uncertainty about certain epidemiological parameters. More sophisticated parameterizations may become hard to manage when it comes to calibrate the parameters. These trade-offs are inevitable. For this study, I chose a rather parsimonious parameterization, and I did some preliminary tests with other parameterizations. The simulation captures the general trend in kinship structure. Formal model selection techniques may help to improve the accuracy of the estimates.

The evaluation of uncertainty for the outputs of the microsimulation is limited by the nature of the available data. We only have point estimates for projected demographic rates. These estimates are part of a 'medium scenario'. To incorporate the growing uncertainty with time, we would need stochastic forecasts for the demographic rates of interest. This is certainly an important limitation driven by the data availability for this specific case. However, a viable option is to follow the approach of the United Nations and thus produce outputs for several scenarios. This way, we could attach measures of kinship resources to official estimates and projections generated by the United Nations.

A final limitation that I want to discuss is related to the geographic unit of analysis. I presented results for the country of Zimbabwe as a whole. However, it may be relevant to disaggregate the analysis by region within Zimbabwe. Different areas of the country are affected in different ways by the epidemic, and social practices vary substantially from urban to rural areas. Evaluating spatial heterogeneity is important, but it requires estimates and projections of demographic rates at a fine geographical level, which are not available. Based on the Demographic and Health Surveys, it would be possible to parameterize a microsimulation model by region for some years in the 1990s and 2000s. Speculations about the future may be based on hypotheses about future demographic dynamics in the different regions of the country.

7.4 Suggestions for future research

This dissertation has been an exciting learning process that is far from being over with the end of this chapter. When I first was introduced to the demography of kinship, I was fascinated by the strong link between socio-anthropological theory and formal demographic analysis. At the same time, I was struck by the potential that demographic microsimulation has for applications to major issues of contemporary societies. A couple of papers on orphanhood that I read at that time sparked my curiosity for the theme of this dissertation. Since then, research questions in the agenda have been multiplying, and with them my enthusiasm to address the main issues. Here I propose some avenues of research that I will pursue in the near future.

Kinship structure strongly interacts with the socio-economic context. Obligations and economic resources of uncles and aunts may depend on the region of the country. Churches and non-governmental organizations may have a stronger role in mitigating the adverse effects of the epidemic in urban areas than in rural villages. Behaviors, attitudes and economic resources may depend on the overall prevalence level of the epidemic. The availability of kinship resources for children can be weighted by these factors. I see some potential for linking the results of the microsimulation with analyses of the Demographic and Health Surveys to generate a new index of kinship resources for children. The index would be a weighted average of the number of members belonging to the same kin group of the child. The weights would be proportional to the relative importance in providing support.

This dissertation focuses on one country. The results can be generalized beyond Zimbabwe. I believe that it would be important to produce generalizations in the spirit of model life tables. Different patterns of mortality typical of societies affected by the HIV/AIDS epidemic can be used as input for the microsimulation. As output, we would have a series of measures of kinship resources associated to different levels of adult HIV prevalence, or life expectancy. This general model would allow us to evaluate the effect of a change of one percentage point in HIV prevalence, or one year of life expectancy, on an index of kinship resources.

Typical patterns of HIV/AIDS mortality may tend to bias kinship structure towards certain forms of care for orphans. The characteristic sex and age-specific profile of mortality may tend to favor survival of certain specific members of the kinship group of orphans. Those members who are relatively more abundant may be more likely to become the caregivers for orphans. With time, their role may become institutionalized. I think that the study of the demographic pressure towards the formation of certain social organizations will be a fruitful area of research.

Finally, there are a series of methodological aspects related to demographic microsimulation that I intend to address. Improving the parameterization of the model, the calibration, and statistical inference for the quantities of interest is central. Some approaches to model selection and calibration are limited by computing power. I see the development of appropriate computer algorithms a crucial problem for statistical inference for demographic microsimulations. Improving the efficiency of computer algorithms is also relevant for the field of stochastic kinship forecasting.

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Appendix A

Demographic rates

Table A.1: Estimates of age-specific fertility rates (births per thousand women) for Zimbabwe for the period 1980-1989. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
15	6.7	7.9	9.4	11.2	13.3	15.7	18.2	21	23.9	26.7
16	55.8	55.9	56.1	56.4	56.7	57.2	57.7	58.2	58.8	59.4
17	104.8	103.8	102.7	101.5	100.1	98.6	97.1	95.4	93.7	91.9
18	152.8	150.8	148.4	145.7	142.6	139.3	135.7	131.9	127.9	123.9
19	198.1	195	191.4	187.3	182.6	177.5	172	166.2	160.2	154.1
20	238.5	234.6	229.9	224.5	218.4	211.7	204.5	197	189.1	181.4
21	272.4	267.7	262.1	255.7	248.3	240.3	231.7	222.7	213.5	204.5
22	297.8	292.6	286.3	279	270.7	261.7	252.1	242.1	232	222.2
23	314.4	308.9	302.2	294.3	285.4	275.6	265.3	254.8	244.4	234.4
24	323.3	317.6	310.8	302.6	293.2	283.1	272.4	261.8	251.4	241.6
25	325.8	320.1	313.2	304.9	295.4	285.1	274.5	263.9	253.8	244.5
26	323.1	317.5	310.7	302.4	293	282.9	272.4	262.1	252.5	243.7
27	316.5	311	304.3	296.3	287.2	277.3	267.3	257.4	248.2	239.8
28	307	301.7	295.2	287.5	278.9	269.5	260	250.6	241.8	233.6
29	295.8	290.7	284.5	277.2	269.1	260.3	251.4	242.5	234	226.1
30	284.1	279.1	273.2	266.4	258.8	250.7	242.3	233.9	225.7	217.9
31	272.9	268	262.4	256	249	241.4	233.6	225.6	217.7	210
32	263.3	258.6	253.2	247.2	240.6	233.5	226.1	218.5	210.8	203.2
33	255.4	250.8	245.7	239.9	233.6	226.8	219.8	212.4	205	197.5
34	248.2	243.8	238.8	233.2	227.1	220.6	213.8	206.7	199.5	192.1
35	240.7	236.4	231.5	226.2	220.3	214	207.4	200.5	193.5	186.4
36	231.8	227.7	223	217.9	212.2	206.1	199.7	193.1	186.3	179.4
37	220.6	216.7	212.2	207.3	201.9	196.1	189.9	183.6	177	170.3
38	206.9	203.2	199.1	194.4	189.3	183.8	178	171.9	165.7	159.3
39	191.5	188.1	184.2	179.9	175.1	170	164.5	158.8	152.8	146.7
40	175.1	171.9	168.4	164.4	160	155.3	150.2	144.8	139.2	133.4
41	158.4	155.5	152.3	148.7	144.7	140.3	135.7	130.7	125.5	120
42	142.2	139.6	136.7	133.4	129.8	125.9	121.6	117.1	112.3	107.2
43	126.7	124.4	121.8	118.9	115.7	112.1	108.3	104.2	99.8	95.2
44	111.8	109.8	107.5	105	102.1	99	95.6	91.9	88	83.8
45	97.4	95.6	93.7	91.4	89	86.2	83.2	80	76.5	72.8
46	83.2	81.7	80.1	78.2	76	73.7	71.2	68.4	65.4	62.2
47	69.1	67.9	66.5	65	63.2	61.3	59.1	56.8	54.3	51.6
48	55	54.1	53	51.8	50.4	48.9	47.1	45.3	43.2	41
49	40.9	40.2	39.5	38.6	37.6	36.4	35.1	33.7	32.2	30.5

Table A.2: Estimates and projections of age-specific fertility rates (births per thousand women) for Zimbabwe for the period 1990-1999. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
15	29.2	30.9	31.5	30.7	28.5	25.6	22.5	19.8	18.2	17.6
16	59.8	59.9	59.7	58.9	57.8	56.3	54.7	53.3	52.2	51.5
17	90.3	88.9	87.8	87.2	87	87	87	86.8	86.2	85.2
18	120.3	117.4	115.5	114.9	115.6	116.9	118.4	119.3	119.3	118
19	148.7	144.3	141.6	141	142.3	144.7	147.3	149.2	149.4	148
20	174.4	168.8	165.2	164.4	165.9	168.9	172.1	174.5	174.9	173.1
21	196.3	189.7	185.4	184	185.2	188	191.2	193.4	193.7	191.6
22	213.4	206.1	201	198.7	199	200.7	202.9	204.3	204	201.6
23	225.4	217.7	211.9	208.4	207	207	207.3	207.3	206	203.3
24	232.7	224.9	218.5	213.7	210.3	208	206.1	204.2	201.8	198.8
25	235.9	228.1	221.2	215.1	209.8	205.1	201	197.3	193.7	190.4
26	235.5	227.8	220.4	213.3	206.3	199.8	193.8	188.4	183.9	180.3
27	231.9	224.3	216.7	208.9	201	193.2	186	179.7	174.6	170.8
28	225.9	218.3	210.7	202.7	194.4	186.3	178.7	172.1	166.8	162.8
29	218.4	210.8	203.2	195.3	187.2	179.3	171.9	165.3	160.1	156.1
30	210.2	202.7	195.1	187.5	179.8	172.4	165.5	159.3	154.2	150.1
31	202.3	194.8	187.4	180	172.8	165.9	159.5	153.7	148.8	144.6
32	195.6	188.1	180.7	173.6	166.7	160.2	154.1	148.5	143.5	139.1
33	190	182.5	175.3	168.2	161.4	154.9	148.9	143.2	138.1	133.5
34	184.8	177.4	170.2	163.1	156.3	149.7	143.5	137.6	132.3	127.4
35	179.2	172	164.8	157.7	150.7	143.9	137.4	131.3	125.7	120.6
36	172.4	165.3	158.2	151	143.9	137	130.3	124	118.1	112.8
37	163.6	156.7	149.6	142.5	135.4	128.4	121.6	115.2	109.3	104
38	152.7	146	139.2	132.2	125.1	118.2	111.5	105.2	99.4	94.2
39	140.4	134	127.3	120.6	113.7	107	100.5	94.3	88.8	83.8
40	127.4	121.2	114.9	108.4	101.8	95.4	89.1	83.3	78	73.4
41	114.4	108.5	102.5	96.3	90.1	84	78.1	72.6	67.7	63.3
42	101.9	96.4	90.8	85	79.1	73.4	67.9	62.8	58.2	54.2
43	90.3	85.2	80	74.6	69.2	63.9	58.8	54	49.8	46.1
44	79.4	74.8	70	65.1	60.1	55.2	50.4	46	42.1	38.7
45	68.9	64.8	60.5	56.1	51.5	47	42.7	38.7	35	31.9
46	58.8	55.2	51.4	47.4	43.3	39.2	35.3	31.6	28.3	25.4
47	48.7	45.6	42.3	38.8	35.2	31.6	28	24.7	21.7	19.1
48	38.6	36.1	33.3	30.3	27.1	23.9	20.7	17.8	15.1	12.8
49	28.6	26.5	24.2	21.7	19	16.2	13.5	10.8	8.5	6.4

Table A.3: Projections of age-specific fertility rates (births per thousand women) for Zimbabwe for the period 2000-2009. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
15	17.9	18.5	19.3	19.7	19.7	19.3	18.7	18	17.2	16.4
16	50.9	50.5	50.1	49.5	48.8	48	47	46	45	43.9
17	83.9	82.4	80.9	79.4	78	76.6	75.4	74.1	72.8	71.5
18	116	113.5	110.8	108.4	106.3	104.5	102.9	101.4	99.9	98.3
19	145.2	141.8	138.2	135	132.4	130.2	128.3	126.5	124.8	123
20	169.9	165.8	161.5	157.7	154.6	152.1	149.9	148	146.1	144.2
21	188	183.5	178.9	174.7	171.4	168.7	166.4	164.4	162.4	160.4
22	197.9	193.4	188.8	184.7	181.4	178.6	176.3	174.3	172.3	170.4
23	199.6	195.4	191.3	187.6	184.5	181.9	179.7	177.7	175.9	174
24	195.3	191.7	188.2	185	182.3	180	177.9	176.1	174.3	172.7
25	187.2	184.2	181.4	178.8	176.5	174.5	172.5	170.8	169.2	167.7
26	177.3	174.9	172.7	170.7	168.7	166.8	165	163.4	161.8	160.5
27	168	165.8	164	162.2	160.5	158.7	156.9	155.2	153.7	152.3
28	160	157.8	156	154.3	152.5	150.7	148.9	147.1	145.5	144
29	153	150.7	148.7	146.8	144.9	142.9	141	139.1	137.3	135.6
30	146.9	144.2	141.9	139.7	137.5	135.3	133.2	131.1	129.1	127.3
31	141.1	138	135.3	132.7	130.2	127.8	125.5	123.2	121.1	119
32	135.3	131.8	128.7	125.8	123	120.4	117.9	115.5	113.1	110.9
33	129.3	125.5	122	118.8	115.8	113	110.3	107.7	105.3	102.9
34	122.9	118.8	115.1	111.6	108.4	105.4	102.6	100	97.5	95.1
35	115.9	111.6	107.6	104	100.7	97.7	94.8	92.2	89.6	87.2
36	108	103.6	99.6	96	92.7	89.6	86.8	84.1	81.6	79.3
37	99.2	94.8	90.9	87.3	84	81.1	78.3	75.8	73.4	71.2
38	89.5	85.3	81.5	78.1	75	72.2	69.6	67.2	65	62.9
39	79.4	75.4	71.9	68.7	65.8	63.2	60.8	58.7	56.7	54.8
40	69.2	65.6	62.3	59.4	56.8	54.5	52.3	50.4	48.6	46.9
41	59.5	56.2	53.2	50.6	48.3	46.2	44.3	42.6	41.1	39.6
42	50.7	47.6	45	42.6	40.5	38.7	37.1	35.6	34.3	33
43	42.8	40	37.6	35.5	33.7	32.1	30.6	29.4	28.2	27.2
44	35.7	33.2	31	29.1	27.5	26.1	24.8	23.8	22.8	21.9
45	29.2	26.9	24.9	23.2	21.7	20.5	19.5	18.6	17.8	17.1
46	23	20.9	19.1	17.5	16.3	15.2	14.4	13.6	13	12.5
47	16.9	15	13.4	12	10.9	10.1	9.4	8.8	8.3	8
48	10.8	9.1	7.7	6.5	5.6	4.9	4.4	4	3.7	3.4
49	4.7	3.2	2	1	0.3	0	0	0	0	0

Table A.4: Projections of age-specific fertility rates (births per thousand women) for Zimbabwe for the period 2010-2019. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
15	15.6	14.7	13.8	12.8	11.7	10.6	9.4	8.2	6.9	5.7
16	42.9	41.8	40.6	39.5	38.3	37.1	35.8	34.6	33.3	32
17	70.1	68.8	67.5	66.1	64.8	63.5	62.2	60.9	59.6	58.4
18	96.7	95.1	93.6	92.1	90.7	89.3	87.9	86.6	85.3	84
19	121.2	119.5	117.7	116.1	114.6	113.1	111.8	110.4	109.1	107.9
20	142.3	140.4	138.6	136.9	135.3	133.8	132.4	131.1	129.9	128.6
21	158.4	156.5	154.7	153	151.4	150	148.6	147.4	146.2	145.1
22	168.5	166.6	164.8	163.2	161.8	160.4	159.2	158	157	155.9
23	172.3	170.6	169	167.5	166.2	165	164	162.9	162	161.1
24	171.1	169.6	168.3	167	165.9	164.9	163.9	163.1	162.3	161.5
25	166.3	165	163.9	162.8	161.8	160.9	160.1	159.4	158.7	158.1
26	159.2	158.1	157	156.1	155.2	154.4	153.6	153	152.4	151.8
27	151.1	149.9	148.9	147.9	147	146.2	145.4	144.7	144.1	143.5
28	142.7	141.4	140.2	139.2	138.1	137.2	136.3	135.4	134.7	134
29	134.1	132.6	131.3	130	128.8	127.6	126.5	125.5	124.5	123.6
30	125.5	123.8	122.2	120.7	119.2	117.8	116.6	115.3	114.2	113.1
31	117	115.1	113.2	111.5	109.8	108.3	106.8	105.3	104	102.7
32	108.7	106.6	104.6	102.7	100.9	99.2	97.5	95.9	94.4	93
33	100.7	98.5	96.4	94.4	92.5	90.7	88.9	87.2	85.6	84.1
34	92.8	90.6	88.4	86.4	84.5	82.6	80.8	79.1	77.5	75.9
35	84.9	82.8	80.7	78.7	76.7	74.9	73.1	71.4	69.8	68.2
36	77.1	75	72.9	71	69.2	67.4	65.6	64	62.4	60.8
37	69.1	67.1	65.2	63.3	61.6	59.9	58.3	56.7	55.2	53.7
38	61	59.1	57.4	55.7	54.1	52.5	51	49.5	48.1	46.7
39	53	51.3	49.8	48.2	46.7	45.3	43.9	42.6	41.2	40
40	45.4	43.9	42.5	41.1	39.8	38.5	37.3	36	34.9	33.7
41	38.2	37	35.7	34.5	33.4	32.2	31.2	30.1	29	28
42	31.8	30.7	29.7	28.7	27.7	26.7	25.8	24.8	23.9	23
43	26.2	25.2	24.4	23.5	22.7	21.9	21.1	20.3	19.5	18.7
44	21.1	20.3	19.6	18.9	18.2	17.6	16.9	16.3	15.6	15
45	16.4	15.8	15.2	14.7	14.2	13.7	13.1	12.6	12.2	11.7
46	12	11.5	11.1	10.7	10.4	10	9.6	9.3	8.9	8.5
47	7.6	7.3	7.1	6.9	6.6	6.4	6.2	6	5.7	5.5
48	3.3	3.2	3.1	3	2.9	2.8	2.8	2.7	2.6	2.5
49	0	0	0	0	0	0	0	0	0	0

Table A.5: Projections of age-specific fertility rates (births per thousand women) for Zimbabwe for the period 2020-2029. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
15	4.4	3	1.7	0.4	0	0	0	0	0	0
16	30.7	29.4	28.1	26.9	25.5	24.2	22.9	21.6	20.3	19.1
17	57.1	55.8	54.6	53.3	52.1	50.9	49.7	48.5	47.3	46.1
18	82.8	81.6	80.4	79.2	78	76.9	75.7	74.6	73.6	72.5
19	106.7	105.5	104.3	103.2	102.1	101.1	100.1	99.1	98.1	97.1
20	127.5	126.3	125.3	124.2	123.2	122.3	121.4	120.5	119.6	118.8
21	144	142.9	141.9	141	140.1	139.3	138.5	137.7	137	136.3
22	155	154.1	153.2	152.4	151.6	150.9	150.3	149.6	149	148.5
23	160.3	159.5	158.8	158.2	157.6	157	156.5	156	155.5	155.1
24	160.9	160.3	159.7	159.2	158.7	158.2	157.8	157.5	157.1	156.8
25	157.6	157.1	156.6	156.2	155.8	155.5	155.1	154.9	154.6	154.4
26	151.3	150.8	150.4	150	149.7	149.4	149.1	148.9	148.7	148.5
27	143	142.5	142	141.6	141.2	140.9	140.6	140.3	140	139.8
28	133.3	132.7	132.1	131.6	131.1	130.6	130.2	129.8	129.4	129.1
29	122.8	122	121.3	120.6	119.9	119.3	118.7	118.1	117.6	117.1
30	112	111	110.1	109.2	108.4	107.5	106.8	106	105.3	104.6
31	101.5	100.3	99.2	98.1	97	96.1	95.1	94.2	93.3	92.4
32	91.6	90.3	89	87.8	86.6	85.5	84.4	83.3	82.3	81.3
33	82.6	81.2	79.8	78.5	77.2	76	74.8	73.7	72.6	71.5
34	74.4	72.9	71.5	70.1	68.8	67.5	66.3	65.1	63.9	62.8
35	66.7	65.2	63.8	62.4	61	59.7	58.5	57.3	56.1	54.9
36	59.3	57.9	56.5	55.1	53.8	52.5	51.3	50.1	48.9	47.8
37	52.2	50.8	49.5	48.2	46.9	45.7	44.5	43.3	42.1	41
38	45.3	44	42.7	41.5	40.3	39.1	37.9	36.8	35.7	34.7
39	38.7	37.5	36.3	35.1	34	32.9	31.8	30.8	29.8	28.8
40	32.6	31.5	30.4	29.3	28.3	27.3	26.3	25.3	24.4	23.5
41	27	26	25	24.1	23.2	22.3	21.4	20.5	19.7	18.8
42	22.1	21.3	20.4	19.6	18.8	18	17.2	16.4	15.7	14.9
43	18	17.2	16.5	15.8	15.1	14.4	13.7	13.1	12.4	11.8
44	14.4	13.8	13.2	12.6	12	11.4	10.8	10.3	9.7	9.2
45	11.2	10.7	10.2	9.7	9.2	8.8	8.3	7.9	7.4	7
46	8.2	7.8	7.5	7.1	6.8	6.4	6.1	5.7	5.4	5.1
47	5.3	5.1	4.8	4.6	4.4	4.1	3.9	3.7	3.4	3.2
48	2.4	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4
49	0	0	0	0	0	0	0	0	0	0

Table A.6: Projections of age-specific fertility rates (births per thousand women) for Zimbabwe for the period 2030-2039. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
15	0	0	0	0	0	0	0	0	0	0
16	17.8	16.5	15.2	13.9	12.6	11.4	10.1	8.8	7.6	6.3
17	44.9	43.7	42.6	41.4	40.3	39.2	38.1	37	35.9	34.8
18	71.4	70.4	69.4	68.4	67.4	66.4	65.4	64.5	63.5	62.6
19	96.2	95.3	94.4	93.5	92.7	91.8	91	90.2	89.5	88.7
20	118	117.2	116.4	115.7	115	114.3	113.7	113	112.4	111.8
21	135.6	135	134.3	133.7	133.2	132.6	132.1	131.6	131.1	130.7
22	147.9	147.4	146.9	146.5	146.1	145.7	145.3	144.9	144.6	144.3
23	154.7	154.3	154	153.6	153.4	153.1	152.9	152.6	152.4	152.2
24	156.5	156.3	156.1	155.8	155.7	155.5	155.4	155.2	155.1	155
25	154.2	154	153.8	153.7	153.6	153.5	153.4	153.4	153.3	153.3
26	148.3	148.1	148	147.9	147.8	147.7	147.7	147.6	147.6	147.5
27	139.5	139.3	139.2	139	138.9	138.8	138.7	138.5	138.4	138.4
28	128.7	128.4	128.1	127.9	127.6	127.4	127.2	127	126.8	126.6
29	116.6	116.1	115.7	115.3	114.9	114.5	114.1	113.8	113.4	113.1
30	104	103.3	102.7	102.1	101.6	101	100.5	100	99.5	99
31	91.6	90.8	90.1	89.3	88.6	87.9	87.2	86.6	85.9	85.3
32	80.4	79.4	78.5	77.7	76.8	76	75.2	74.4	73.6	72.9
33	70.4	69.4	68.4	67.5	66.5	65.6	64.7	63.9	63	62.2
34	61.7	60.6	59.6	58.5	57.6	56.6	55.7	54.7	53.9	53
35	53.8	52.7	51.7	50.6	49.6	48.6	47.7	46.7	45.8	44.9
36	46.7	45.6	44.5	43.5	42.5	41.5	40.5	39.6	38.7	37.8
37	40	38.9	37.9	36.9	35.9	34.9	34	33.1	32.2	31.3
38	33.6	32.6	31.7	30.7	29.8	28.8	27.9	27.1	26.2	25.4
39	27.8	26.9	26	25.1	24.2	23.3	22.5	21.6	20.8	20
40	22.6	21.7	20.9	20	19.2	18.4	17.6	16.9	16.1	15.4
41	18	17.2	16.5	15.7	15	14.3	13.5	12.9	12.2	11.5
42	14.2	13.5	12.8	12.2	11.5	10.9	10.3	9.6	9	8.4
43	11.2	10.6	10	9.4	8.8	8.3	7.7	7.2	6.7	6.2
44	8.7	8.2	7.7	7.2	6.7	6.2	5.8	5.3	4.9	4.5
45	6.6	6.2	5.8	5.4	5	4.6	4.3	3.9	3.5	3.2
46	4.8	4.4	4.1	3.8	3.5	3.3	3	2.7	2.4	2.2
47	3	2.8	2.6	2.4	2.2	2	1.8	1.6	1.4	1.3
48	1.3	1.1	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3
49	0	0	0	0	0	0	0	0	0	0

Table A.7: Projections of age-specific fertility rates (births per thousand women) for Zimbabwe for the period 2040-2050. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
15	0	0	0	0	0	0	0	0	0	0	0
16	5	3.8	2.5	1.3	0	0	0	0	0	0	0
17	33.7	32.6	31.5	30.4	29.4	28.3	27.2	26.2	25.1	24	23
18	61.7	60.8	59.9	59	58.1	57.2	56.3	55.4	54.6	53.7	52.8
19	87.9	87.2	86.4	85.7	85	84.3	83.6	82.9	82.2	81.5	80.9
20	111.2	110.6	110	109.4	108.9	108.4	107.9	107.3	106.8	106.3	105.8
21	130.2	129.8	129.4	129	128.6	128.2	127.9	127.5	127.2	126.8	126.5
22	143.9	143.6	143.4	143.1	142.9	142.6	142.4	142.2	142	141.8	141.6
23	152	151.8	151.7	151.5	151.4	151.3	151.2	151.1	151.1	151	150.9
24	154.9	154.8	154.7	154.7	154.7	154.7	154.7	154.7	154.7	154.7	154.7
25	153.2	153.2	153.2	153.2	153.2	153.2	153.3	153.4	153.4	153.5	153.6
26	147.5	147.4	147.4	147.4	147.5	147.5	147.6	147.7	147.7	147.8	147.9
27	138.3	138.2	138.1	138.1	138.1	138.1	138.1	138.1	138.1	138.1	138.1
28	126.4	126.2	126	125.9	125.8	125.7	125.6	125.5	125.4	125.3	125.2
29	112.8	112.5	112.2	111.9	111.7	111.4	111.2	110.9	110.7	110.5	110.2
30	98.6	98.1	97.7	97.2	96.8	96.4	96	95.6	95.3	94.9	94.5
31	84.7	84.1	83.5	83	82.4	81.9	81.3	80.8	80.3	79.7	79.2
32	72.2	71.5	70.8	70.1	69.4	68.8	68.1	67.5	66.8	66.2	65.5
33	61.4	60.6	59.9	59.1	58.3	57.6	56.9	56.1	55.4	54.7	53.9
34	52.1	51.3	50.5	49.6	48.8	48.1	47.3	46.5	45.7	44.9	44.1
35	44	43.2	42.3	41.5	40.7	39.9	39	38.2	37.4	36.6	35.8
36	36.9	36	35.2	34.3	33.5	32.7	31.9	31.1	30.3	29.5	28.7
37	30.4	29.6	28.7	27.9	27.1	26.3	25.5	24.7	23.9	23.1	22.3
38	24.5	23.7	22.9	22.1	21.3	20.6	19.8	19	18.3	17.5	16.7
39	19.3	18.5	17.7	17	16.2	15.5	14.8	14.1	13.3	12.6	11.9
40	14.7	14	13.3	12.6	11.9	11.2	10.5	9.9	9.2	8.5	7.8
41	10.9	10.2	9.6	8.9	8.3	7.7	7.1	6.5	5.9	5.2	4.6
42	7.9	7.3	6.7	6.2	5.6	5.1	4.5	4	3.4	2.9	2.3
43	5.6	5.1	4.7	4.2	3.7	3.2	2.7	2.3	1.8	1.3	0.8
44	4	3.6	3.2	2.8	2.4	2	1.6	1.2	0.8	0.4	0
45	2.8	2.5	2.2	1.9	1.5	1.2	0.9	0.6	0.2	0	0
46	1.9	1.7	1.4	1.2	0.9	0.7	0.4	0.2	0	0	0
47	1.1	0.9	0.8	0.6	0.4	0.3	0.1	0	0	0	0
48	0.3	0.2	0.1	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0

Table A.8: Estimates of probabilities of survival, l_x, for males in absence of AIDS in Zimbabwe for the period 1980-1989. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	1	1	1	1	1	1	1	1	1	1
1	0.895	0.899	0.903	0.907	0.91	0.914	0.918	0.922	0.927	0.934
2	0.89	0.895	0.899	0.903	0.906	0.91	0.913	0.917	0.923	0.929
3	0.886	0.891	0.895	0.898	0.902	0.905	0.909	0.913	0.918	0.925
4	0.882	0.886	0.891	0.894	0.898	0.901	0.905	0.909	0.914	0.92
5	0.878	0.882	0.886	0.89	0.893	0.897	0.9	0.904	0.91	0.916
6	0.875	0.879	0.884	0.887	0.891	0.894	0.898	0.902	0.908	0.914
7	0.872	0.877	0.881	0.885	0.888	0.892	0.895	0.9	0.905	0.912
8	0.869	0.874	0.878	0.882	0.886	0.889	0.893	0.898	0.903	0.91
9	0.867	0.871	0.876	0.88	0.883	0.887	0.891	0.895	0.901	0.908
10	0.864	0.869	0.873	0.877	0.881	0.884	0.888	0.893	0.899	0.906
11	0.862	0.867	0.871	0.875	0.879	0.882	0.886	0.891	0.897	0.905
12	0.86	0.865	0.869	0.873	0.877	0.88	0.885	0.89	0.896	0.903
13	0.858	0.863	0.867	0.871	0.875	0.879	0.883	0.888	0.894	0.902
14	0.856	0.861	0.865	0.869	0.873	0.877	0.881	0.886	0.893	0.9
15	0.854	0.859	0.863	0.867	0.871	0.875	0.879	0.884	0.891	0.899
16	0.851	0.856	0.861	0.865	0.868	0.872	0.877	0.882	0.889	0.896
17	0.849	0.853	0.858	0.862	0.866	0.87	0.874	0.88	0.886	0.894
18	0.846	0.851	0.855	0.859	0.863	0.867	0.872	0.877	0.884	0.892
19	0.843	0.848	0.853	0.857	0.861	0.865	0.869	0.875	0.882	0.89
20	0.841	0.846	0.85	0.854	0.858	0.862	0.867	0.873	0.88	0.888
21	0.837	0.842	0.847	0.851	0.855	0.859	0.864	0.869	0.876	0.885
22	0.834	0.839	0.843	0.847	0.851	0.856	0.86	0.866	0.873	0.882
23	0.83	0.835	0.84	0.844	0.848	0.852	0.857	0.863	0.87	0.879
24	0.826	0.832	0.836	0.841	0.845	0.849	0.854	0.86	0.867	0.876
25	0.823	0.828	0.833	0.837	0.841	0.846	0.85	0.856	0.864	0.873
26	0.819	0.824	0.829	0.833	0.837	0.842	0.847	0.853	0.861	0.87
27	0.815	0.82	0.825	0.83	0.834	0.838	0.843	0.849	0.857	0.866
28	0.811	0.817	0.821	0.826	0.83	0.834	0.84	0.846	0.854	0.863
29	0.808	0.813	0.818	0.822	0.826	0.831	0.836	0.842	0.85	0.86
30	0.804	0.809	0.814	0.818	0.822	0.827	0.832	0.839	0.847	0.857
31	0.8	0.805	0.81	0.814	0.819	0.823	0.829	0.835	0.844	0.853
32	0.796	0.801	0.806	0.811	0.815	0.82	0.825	0.832	0.84	0.85
33	0.792	0.797	0.802	0.807	0.811	0.816	0.821	0.828	0.837	0.847

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AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
34	0.788	0.793	0.798	0.803	0.807	0.812	0.818	0.825	0.833	0.843
35	0.784	0.789	0.795	0.799	0.804	0.809	0.814	0.821	0.83	0.84
36	0.78	0.785	0.79	0.795	0.799	0.804	0.81	0.817	0.826	0.837
37	0.776	0.781	0.786	0.79	0.795	0.799	0.805	0.813	0.822	0.833
38	0.772	0.777	0.781	0.786	0.79	0.795	0.801	0.809	0.818	0.829
39	0.768	0.773	0.777	0.781	0.785	0.791	0.797	0.805	0.815	0.826
40	0.764	0.768	0.773	0.777	0.781	0.786	0.793	0.801	0.811	0.822
41	0.759	0.763	0.768	0.772	0.776	0.781	0.788	0.796	0.806	0.818
42	0.753	0.758	0.763	0.767	0.771	0.777	0.783	0.791	0.801	0.813
43	0.748	0.753	0.758	0.762	0.767	0.772	0.778	0.787	0.797	0.808
44	0.743	0.748	0.753	0.757	0.762	0.767	0.774	0.782	0.792	0.804
45	0.738	0.743	0.748	0.753	0.757	0.763	0.769	0.777	0.788	0.799
46	0.731	0.737	0.742	0.747	0.751	0.756	0.763	0.771	0.782	0.794
47	0.725	0.731	0.736	0.74	0.745	0.75	0.757	0.765	0.776	0.788
48	0.719	0.725	0.73	0.734	0.739	0.744	0.751	0.759	0.77	0.783
49	0.713	0.719	0.724	0.728	0.733	0.738	0.745	0.754	0.764	0.777
50	0.707	0.713	0.718	0.722	0.727	0.732	0.739	0.748	0.759	0.772
51	0.699	0.705	0.71	0.714	0.719	0.724	0.731	0.74	0.751	0.764
52	0.691	0.697	0.702	0.706	0.711	0.716	0.723	0.732	0.743	0.757
53	0.683	0.689	0.694	0.698	0.703	0.709	0.716	0.725	0.736	0.749
54	0.675	0.681	0.686	0.69	0.695	0.701	0.708	0.717	0.729	0.742
55	0.667	0.673	0.678	0.683	0.688	0.693	0.7	0.71	0.721	0.735
56	0.657	0.662	0.667	0.672	0.677	0.683	0.69	0.699	0.711	0.725
57	0.646	0.652	0.657	0.662	0.667	0.673	0.68	0.689	0.701	0.715
58	0.636	0.642	0.647	0.652	0.657	0.662	0.67	0.679	0.691	0.705
59	0.626	0.632	0.637	0.642	0.647	0.653	0.66	0.669	0.681	0.696
60	0.616	0.622	0.627	0.632	0.637	0.643	0.65	0.66	0.672	0.686
61	0.602	0.607	0.612	0.617	0.622	0.628	0.636	0.645	0.658	0.672
62	0.588	0.594	0.598	0.603	0.608	0.614	0.621	0.631	0.644	0.659
63	0.575	0.58	0.584	0.589	0.594	0.6	0.607	0.618	0.631	0.646
64	0.562	0.567	0.571	0.575	0.58	0.586	0.594	0.604	0.618	0.633
65	0.55	0.554	0.558	0.562	0.566	0.572	0.581	0.591	0.605	0.62
66	0.53	0.534	0.538	0.542	0.547	0.553	0.561	0.572	0.585	0.601
67	0.51	0.515	0.519	0.523	0.528	0.534	0.542	0.553	0.566	0.582
68	0.492	0.497	0.501	0.505	0.51	0.516	0.524	0.534	0.548	0.563
69	0.474	0.479	0.483	0.488	0.492	0.498	0.506	0.517	0.53	0.545

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AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
70	0.457	0.462	0.466	0.471	0.476	0.482	0.489	0.5	0.513	0.528
71	0.432	0.437	0.442	0.446	0.45	0.456	0.464	0.474	0.487	0.502
72	0.41	0.414	0.418	0.422	0.426	0.432	0.44	0.45	0.463	0.478
73	0.388	0.392	0.396	0.399	0.404	0.409	0.417	0.427	0.44	0.455
74	0.368	0.371	0.375	0.378	0.382	0.387	0.395	0.405	0.417	0.433
75	0.348	0.352	0.355	0.358	0.362	0.367	0.374	0.384	0.397	0.411
76	0.316	0.32	0.323	0.327	0.331	0.336	0.343	0.353	0.364	0.378
77	0.287	0.291	0.295	0.298	0.303	0.308	0.315	0.324	0.335	0.348
78	0.26	0.264	0.268	0.272	0.277	0.282	0.289	0.297	0.308	0.32
79	0.236	0.24	0.245	0.249	0.253	0.258	0.265	0.273	0.283	0.294
80	0.214	0.219	0.223	0.227	0.231	0.237	0.243	0.251	0.26	0.27
∞	0	0	0	0	0	0	0	0	0	0

Table A.9: Estimates of probabilities of survival, l_x, for males in absence of AIDS in Zimbabwe for the period 1990-1999. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	1	1	1	1	1	1	1	1	1	1
1	0.94	0.946	0.951	0.955	0.956	0.955	0.954	0.951	0.949	0.947
2	0.936	0.942	0.947	0.95	0.951	0.951	0.949	0.947	0.945	0.942
3	0.931	0.937	0.942	0.946	0.947	0.946	0.945	0.942	0.94	0.938
4	0.927	0.933	0.938	0.941	0.942	0.942	0.94	0.938	0.936	0.934
5	0.922	0.929	0.934	0.937	0.938	0.937	0.936	0.933	0.931	0.929
6	0.921	0.927	0.932	0.935	0.936	0.936	0.934	0.932	0.93	0.927
7	0.919	0.925	0.93	0.934	0.935	0.934	0.933	0.93	0.928	0.926
8	0.917	0.924	0.929	0.932	0.933	0.933	0.931	0.929	0.926	0.924
9	0.915	0.922	0.927	0.931	0.932	0.931	0.93	0.927	0.925	0.922
10	0.914	0.92	0.926	0.929	0.93	0.93	0.928	0.926	0.923	0.921
11	0.912	0.919	0.925	0.928	0.929	0.929	0.927	0.924	0.922	0.919
12	0.911	0.918	0.923	0.927	0.928	0.928	0.926	0.923	0.921	0.918
13	0.909	0.916	0.922	0.926	0.927	0.926	0.924	0.922	0.919	0.917
14	0.908	0.915	0.921	0.925	0.926	0.925	0.923	0.921	0.918	0.915
15	0.906	0.914	0.92	0.923	0.925	0.924	0.922	0.919	0.917	0.914
16	0.904	0.912	0.918	0.922	0.923	0.922	0.92	0.918	0.915	0.912
17	0.902	0.91	0.916	0.92	0.921	0.92	0.918	0.916	0.913	0.91
18	0.9	0.908	0.914	0.918	0.919	0.918	0.916	0.914	0.911	0.908
19	0.898	0.906	0.912	0.916	0.917	0.917	0.915	0.912	0.909	0.906
20	0.896	0.904	0.91	0.914	0.916	0.915	0.913	0.91	0.907	0.904
21	0.893	0.901	0.908	0.912	0.913	0.912	0.91	0.907	0.904	0.902
22	0.89	0.899	0.905	0.909	0.91	0.91	0.907	0.905	0.902	0.899
23	0.888	0.896	0.902	0.906	0.908	0.907	0.905	0.902	0.899	0.896
24	0.885	0.893	0.9	0.904	0.905	0.904	0.902	0.899	0.896	0.893
25	0.882	0.89	0.897	0.901	0.903	0.902	0.899	0.896	0.893	0.89
26	0.879	0.887	0.894	0.898	0.9	0.899	0.897	0.894	0.89	0.887
27	0.876	0.884	0.891	0.896	0.897	0.896	0.894	0.891	0.887	0.884
28	0.873	0.882	0.889	0.893	0.894	0.893	0.891	0.888	0.884	0.881
29	0.87	0.879	0.886	0.89	0.891	0.89	0.888	0.885	0.881	0.878
30	0.867	0.876	0.883	0.887	0.888	0.887	0.885	0.882	0.878	0.875
31	0.863	0.873	0.88	0.884	0.885	0.884	0.882	0.879	0.875	0.872
32	0.86	0.87	0.877	0.881	0.883	0.882	0.879	0.876	0.872	0.869
33	0.857	0.866	0.874	0.878	0.88	0.879	0.876	0.873	0.869	0.866

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AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
34	0.854	0.863	0.871	0.875	0.877	0.876	0.873	0.87	0.866	0.863
35	0.851	0.86	0.868	0.873	0.874	0.873	0.87	0.867	0.863	0.86
36	0.847	0.857	0.865	0.869	0.871	0.87	0.867	0.863	0.86	0.856
37	0.844	0.854	0.862	0.866	0.867	0.866	0.864	0.86	0.856	0.853
38	0.84	0.85	0.858	0.863	0.864	0.863	0.86	0.857	0.853	0.849
39	0.837	0.847	0.855	0.86	0.861	0.86	0.857	0.853	0.849	0.846
40	0.834	0.844	0.852	0.856	0.858	0.856	0.854	0.85	0.846	0.843
41	0.829	0.84	0.848	0.853	0.854	0.853	0.85	0.846	0.842	0.838
42	0.825	0.836	0.844	0.849	0.85	0.849	0.846	0.842	0.838	0.834
43	0.82	0.831	0.84	0.845	0.846	0.845	0.842	0.838	0.834	0.83
44	0.816	0.827	0.836	0.841	0.843	0.842	0.838	0.834	0.83	0.826
45	0.812	0.823	0.832	0.837	0.839	0.838	0.835	0.831	0.826	0.822
46	0.806	0.818	0.827	0.832	0.834	0.833	0.83	0.825	0.821	0.817
47	0.801	0.813	0.822	0.827	0.829	0.828	0.825	0.82	0.816	0.812
48	0.795	0.807	0.817	0.822	0.824	0.823	0.82	0.815	0.811	0.807
49	0.79	0.802	0.812	0.817	0.819	0.818	0.815	0.81	0.806	0.801
50	0.785	0.797	0.807	0.812	0.814	0.813	0.81	0.805	0.801	0.796
51	0.777	0.79	0.8	0.805	0.807	0.806	0.803	0.798	0.793	0.789
52	0.77	0.783	0.793	0.799	0.8	0.799	0.796	0.791	0.786	0.782
53	0.763	0.776	0.786	0.792	0.793	0.792	0.789	0.784	0.779	0.775
54	0.756	0.769	0.779	0.785	0.787	0.785	0.782	0.777	0.772	0.768
55	0.749	0.762	0.772	0.778	0.78	0.779	0.775	0.771	0.765	0.761
56	0.739	0.752	0.762	0.769	0.771	0.769	0.766	0.761	0.756	0.751
57	0.729	0.742	0.753	0.759	0.761	0.76	0.756	0.751	0.746	0.741
58	0.72	0.733	0.744	0.75	0.752	0.75	0.747	0.742	0.737	0.732
59	0.71	0.724	0.735	0.741	0.743	0.741	0.738	0.733	0.727	0.723
60	0.701	0.715	0.726	0.732	0.734	0.732	0.728	0.723	0.718	0.713
61	0.687	0.701	0.712	0.719	0.72	0.719	0.715	0.71	0.704	0.699
62	0.674	0.688	0.699	0.705	0.707	0.705	0.701	0.696	0.691	0.686
63	0.661	0.675	0.686	0.692	0.694	0.692	0.688	0.683	0.677	0.672
64	0.648	0.662	0.673	0.68	0.681	0.68	0.675	0.67	0.664	0.659
65	0.636	0.65	0.661	0.667	0.669	0.667	0.663	0.657	0.652	0.647
66	0.616	0.631	0.642	0.648	0.65	0.648	0.643	0.638	0.632	0.627
67	0.597	0.612	0.623	0.629	0.631	0.629	0.625	0.619	0.613	0.608
68	0.579	0.594	0.605	0.611	0.613	0.611	0.606	0.601	0.595	0.59
69	0.561	0.576	0.587	0.594	0.595	0.593	0.589	0.583	0.577	0.572

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AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
70	0.544	0.559	0.57	0.577	0.578	0.576	0.571	0.566	0.56	0.555
71	0.518	0.533	0.544	0.55	0.552	0.55	0.545	0.539	0.534	0.529
72	0.494	0.508	0.519	0.525	0.527	0.525	0.52	0.514	0.509	0.504
73	0.47	0.484	0.495	0.502	0.503	0.501	0.496	0.491	0.485	0.48
74	0.448	0.462	0.473	0.479	0.48	0.478	0.473	0.468	0.462	0.457
75	0.427	0.44	0.451	0.457	0.458	0.456	0.452	0.446	0.441	0.436
76	0.393	0.405	0.415	0.421	0.423	0.421	0.417	0.412	0.407	0.403
77	0.361	0.373	0.383	0.388	0.39	0.388	0.385	0.381	0.376	0.372
78	0.332	0.343	0.352	0.358	0.359	0.358	0.356	0.352	0.348	0.344
79	0.306	0.316	0.324	0.33	0.331	0.331	0.328	0.325	0.321	0.318
80	0.281	0.291	0.299	0.304	0.306	0.305	0.303	0.3	0.297	0.294
∞	0	0	0	0	0	0	0	0	0	0

Table A.10: Estimates of probabilities of survival, l_x, for males in absence of AIDS in Zimbabwe for the period 2000-2009. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	1	1	1	1	1	1	1	1	1	1
1	0.948	0.947	0.945	0.945	0.945	0.944	0.945	0.946	0.948	0.949
2	0.943	0.941	0.94	0.94	0.94	0.939	0.94	0.941	0.943	0.944
3	0.938	0.936	0.935	0.935	0.935	0.934	0.935	0.936	0.938	0.939
4	0.932	0.931	0.93	0.929	0.929	0.929	0.93	0.932	0.933	0.935
5	0.927	0.926	0.925	0.924	0.924	0.925	0.926	0.927	0.928	0.93
6	0.926	0.924	0.923	0.922	0.922	0.923	0.924	0.925	0.927	0.928
7	0.924	0.922	0.921	0.921	0.921	0.921	0.922	0.923	0.925	0.927
8	0.922	0.921	0.919	0.919	0.919	0.919	0.92	0.922	0.923	0.925
9	0.92	0.919	0.918	0.917	0.917	0.918	0.919	0.92	0.922	0.923
10	0.919	0.917	0.916	0.915	0.915	0.916	0.917	0.918	0.92	0.922
11	0.917	0.916	0.914	0.914	0.914	0.914	0.916	0.917	0.919	0.92
12	0.916	0.914	0.913	0.912	0.912	0.913	0.914	0.916	0.917	0.919
13	0.915	0.913	0.912	0.911	0.911	0.912	0.913	0.914	0.916	0.918
14	0.913	0.911	0.91	0.91	0.91	0.91	0.911	0.913	0.915	0.916
15	0.912	0.91	0.909	0.908	0.908	0.909	0.91	0.912	0.913	0.915
16	0.91	0.908	0.907	0.906	0.906	0.907	0.908	0.91	0.911	0.913
17	0.908	0.906	0.905	0.904	0.904	0.905	0.906	0.908	0.909	0.911
18	0.906	0.904	0.903	0.902	0.902	0.903	0.904	0.905	0.907	0.909
19	0.904	0.902	0.901	0.9	0.9	0.901	0.902	0.904	0.905	0.907
20	0.902	0.9	0.899	0.898	0.898	0.899	0.9	0.902	0.903	0.905
21	0.899	0.897	0.896	0.895	0.895	0.896	0.897	0.899	0.901	0.903
22	0.896	0.894	0.893	0.892	0.892	0.893	0.894	0.896	0.898	0.9
23	0.894	0.892	0.89	0.889	0.89	0.89	0.891	0.893	0.895	0.897
24	0.891	0.889	0.887	0.887	0.887	0.887	0.889	0.89	0.892	0.894
25	0.888	0.886	0.884	0.884	0.884	0.885	0.886	0.888	0.89	0.892
26	0.885	0.883	0.881	0.881	0.881	0.882	0.883	0.885	0.887	0.889
27	0.882	0.88	0.878	0.878	0.878	0.878	0.88	0.882	0.884	0.886
28	0.879	0.877	0.875	0.874	0.875	0.875	0.877	0.879	0.881	0.883
29	0.876	0.873	0.872	0.871	0.871	0.872	0.874	0.875	0.878	0.88
30	0.873	0.87	0.869	0.868	0.868	0.869	0.871	0.873	0.875	0.877
31	0.869	0.867	0.866	0.865	0.865	0.866	0.867	0.869	0.871	0.874
32	0.866	0.864	0.862	0.862	0.862	0.863	0.864	0.866	0.868	0.871
33	0.863	0.861	0.859	0.858	0.859	0.86	0.861	0.863	0.865	0.868

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AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
34	0.86	0.858	0.856	0.855	0.855	0.856	0.858	0.86	0.862	0.865
35	0.857	0.854	0.853	0.852	0.852	0.853	0.855	0.857	0.859	0.862
36	0.853	0.851	0.849	0.848	0.849	0.85	0.851	0.853	0.856	0.858
37	0.85	0.847	0.846	0.845	0.845	0.846	0.848	0.85	0.852	0.855
38	0.846	0.844	0.842	0.841	0.841	0.842	0.844	0.846	0.849	0.851
39	0.843	0.84	0.839	0.838	0.838	0.839	0.841	0.843	0.845	0.848
40	0.839	0.837	0.835	0.834	0.834	0.835	0.837	0.839	0.842	0.844
41	0.835	0.833	0.831	0.83	0.83	0.831	0.833	0.835	0.838	0.84
42	0.831	0.828	0.827	0.826	0.826	0.827	0.829	0.831	0.834	0.836
43	0.827	0.824	0.822	0.822	0.822	0.823	0.825	0.827	0.83	0.832
44	0.823	0.82	0.818	0.818	0.818	0.819	0.821	0.823	0.825	0.828
45	0.819	0.816	0.814	0.813	0.814	0.815	0.817	0.819	0.821	0.824
46	0.813	0.811	0.809	0.808	0.808	0.809	0.811	0.814	0.816	0.819
47	0.808	0.805	0.803	0.803	0.803	0.804	0.806	0.808	0.811	0.814
48	0.803	0.8	0.798	0.797	0.797	0.799	0.801	0.803	0.806	0.809
49	0.798	0.795	0.793	0.792	0.792	0.793	0.795	0.798	0.801	0.803
50	0.792	0.789	0.787	0.787	0.787	0.788	0.79	0.793	0.795	0.798
51	0.785	0.782	0.78	0.779	0.78	0.781	0.783	0.785	0.788	0.791
52	0.778	0.775	0.773	0.772	0.772	0.774	0.776	0.778	0.781	0.784
53	0.771	0.768	0.766	0.765	0.765	0.767	0.769	0.771	0.774	0.777
54	0.764	0.761	0.759	0.758	0.758	0.76	0.762	0.764	0.767	0.77
55	0.757	0.754	0.752	0.751	0.751	0.753	0.755	0.757	0.76	0.763
56	0.747	0.744	0.742	0.741	0.741	0.743	0.745	0.747	0.75	0.754
57	0.737	0.734	0.732	0.731	0.731	0.733	0.735	0.738	0.741	0.744
58	0.728	0.725	0.722	0.722	0.722	0.723	0.725	0.728	0.731	0.735
59	0.718	0.715	0.713	0.712	0.712	0.714	0.716	0.719	0.722	0.726
60	0.709	0.706	0.704	0.703	0.703	0.704	0.707	0.71	0.713	0.717
61	0.695	0.692	0.69	0.689	0.689	0.691	0.693	0.696	0.699	0.702
62	0.682	0.679	0.677	0.676	0.676	0.678	0.68	0.682	0.685	0.688
63	0.668	0.665	0.664	0.663	0.664	0.665	0.667	0.669	0.671	0.674
64	0.655	0.652	0.651	0.65	0.651	0.652	0.654	0.656	0.658	0.66
65	0.642	0.64	0.638	0.638	0.639	0.64	0.641	0.643	0.645	0.647
66	0.623	0.62	0.619	0.618	0.619	0.62	0.621	0.623	0.625	0.627
67	0.604	0.601	0.6	0.599	0.6	0.601	0.602	0.604	0.606	0.608
68	0.586	0.583	0.581	0.581	0.581	0.582	0.584	0.585	0.587	0.59
69	0.568	0.565	0.564	0.563	0.564	0.564	0.566	0.567	0.569	0.572

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AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
70	0.551	0.548	0.546	0.546	0.546	0.547	0.548	0.55	0.552	0.555
71	0.525	0.522	0.52	0.52	0.52	0.521	0.522	0.523	0.526	0.528
72	0.5	0.497	0.495	0.494	0.495	0.496	0.497	0.499	0.501	0.504
73	0.476	0.473	0.471	0.471	0.471	0.472	0.473	0.475	0.477	0.48
74	0.453	0.45	0.449	0.448	0.448	0.449	0.451	0.453	0.455	0.457
75	0.432	0.429	0.427	0.426	0.427	0.428	0.429	0.431	0.433	0.436
76	0.399	0.396	0.394	0.394	0.394	0.395	0.396	0.398	0.4	0.402
77	0.368	0.366	0.364	0.363	0.364	0.364	0.366	0.367	0.369	0.372
78	0.34	0.338	0.336	0.335	0.335	0.336	0.337	0.339	0.341	0.343
79	0.314	0.312	0.31	0.31	0.31	0.31	0.311	0.313	0.315	0.317
80	0.291	0.288	0.287	0.286	0.286	0.286	0.287	0.289	0.29	0.293
∞	0	0	0	0	0	0	0	0	0	0

Table A.11: Projections of probabilities of survival, l_x, for males in absence of AIDS in Zimbabwe for the period 2010-2019. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0	1	1	1	1	1	1	1	1	1	1
1	0.948	0.95	0.951	0.953	0.955	0.953	0.955	0.957	0.958	0.96
2	0.944	0.945	0.947	0.949	0.951	0.95	0.952	0.953	0.955	0.956
3	0.94	0.941	0.943	0.945	0.946	0.947	0.948	0.95	0.951	0.953
4	0.936	0.937	0.939	0.941	0.942	0.943	0.945	0.946	0.948	0.95
5	0.931	0.933	0.935	0.936	0.938	0.94	0.941	0.943	0.945	0.946
6	0.93	0.932	0.933	0.935	0.937	0.938	0.94	0.942	0.943	0.945
7	0.928	0.93	0.932	0.933	0.935	0.937	0.939	0.941	0.942	0.944
8	0.927	0.928	0.93	0.932	0.934	0.936	0.937	0.939	0.941	0.943
9	0.925	0.927	0.929	0.931	0.932	0.934	0.936	0.938	0.94	0.941
10	0.923	0.925	0.927	0.929	0.931	0.933	0.935	0.937	0.939	0.94
11	0.922	0.924	0.926	0.928	0.93	0.932	0.934	0.936	0.937	0.939
12	0.921	0.923	0.925	0.927	0.929	0.931	0.933	0.935	0.936	0.938
13	0.92	0.921	0.923	0.925	0.927	0.929	0.931	0.933	0.935	0.937
14	0.918	0.92	0.922	0.924	0.926	0.928	0.93	0.932	0.934	0.936
15	0.917	0.919	0.921	0.923	0.925	0.927	0.929	0.931	0.933	0.935
16	0.915	0.917	0.919	0.921	0.923	0.925	0.927	0.93	0.931	0.933
17	0.913	0.915	0.917	0.919	0.921	0.924	0.926	0.928	0.93	0.932
18	0.911	0.913	0.915	0.917	0.92	0.922	0.924	0.926	0.928	0.93
19	0.909	0.911	0.913	0.916	0.918	0.92	0.922	0.924	0.926	0.928
20	0.907	0.909	0.912	0.914	0.916	0.918	0.92	0.922	0.925	0.927
21	0.905	0.907	0.909	0.911	0.913	0.916	0.918	0.92	0.922	0.924
22	0.902	0.904	0.906	0.909	0.911	0.913	0.915	0.918	0.92	0.922
23	0.899	0.901	0.904	0.906	0.908	0.911	0.913	0.915	0.917	0.919
24	0.896	0.899	0.901	0.903	0.906	0.908	0.91	0.913	0.915	0.917
25	0.894	0.896	0.898	0.901	0.903	0.905	0.908	0.91	0.912	0.914
26	0.891	0.893	0.895	0.898	0.9	0.903	0.905	0.907	0.91	0.912
27	0.888	0.89	0.893	0.895	0.897	0.9	0.902	0.905	0.907	0.909
28	0.885	0.887	0.89	0.892	0.895	0.897	0.9	0.902	0.904	0.907
29	0.882	0.885	0.887	0.889	0.892	0.894	0.897	0.899	0.902	0.904
30	0.879	0.882	0.884	0.887	0.889	0.892	0.894	0.897	0.899	0.901
31	0.876	0.879	0.881	0.884	0.886	0.889	0.891	0.894	0.896	0.899
32	0.873	0.876	0.878	0.881	0.883	0.886	0.889	0.891	0.894	0.896
33	0.87	0.873	0.875	0.878	0.881	0.883	0.886	0.888	0.891	0.893

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AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
34	0.867	0.87	0.872	0.875	0.878	0.88	0.883	0.886	0.888	0.891
35	0.864	0.867	0.869	0.872	0.875	0.878	0.88	0.883	0.886	0.888
36	0.861	0.863	0.866	0.869	0.872	0.874	0.877	0.88	0.883	0.885
37	0.857	0.86	0.863	0.866	0.868	0.871	0.874	0.877	0.88	0.882
38	0.854	0.857	0.86	0.862	0.865	0.868	0.871	0.874	0.877	0.879
39	0.851	0.853	0.856	0.859	0.862	0.865	0.868	0.871	0.874	0.876
40	0.847	0.85	0.853	0.856	0.859	0.862	0.865	0.868	0.871	0.873
41	0.843	0.846	0.849	0.852	0.855	0.858	0.861	0.864	0.867	0.87
42	0.839	0.842	0.845	0.848	0.851	0.854	0.857	0.86	0.863	0.866
43	0.835	0.838	0.841	0.844	0.847	0.851	0.854	0.857	0.86	0.863
44	0.831	0.834	0.837	0.84	0.844	0.847	0.85	0.853	0.856	0.859
45	0.827	0.83	0.833	0.837	0.84	0.843	0.846	0.849	0.853	0.856
46	0.822	0.825	0.828	0.832	0.835	0.838	0.841	0.845	0.848	0.851
47	0.817	0.82	0.823	0.826	0.83	0.833	0.837	0.84	0.843	0.846
48	0.812	0.815	0.818	0.821	0.825	0.828	0.832	0.835	0.838	0.841
49	0.807	0.81	0.813	0.817	0.82	0.823	0.827	0.83	0.834	0.837
50	0.802	0.805	0.808	0.812	0.815	0.819	0.822	0.826	0.829	0.832
51	0.794	0.798	0.801	0.805	0.808	0.812	0.815	0.819	0.822	0.826
52	0.787	0.791	0.794	0.798	0.801	0.805	0.809	0.812	0.816	0.819
53	0.78	0.784	0.787	0.791	0.795	0.798	0.802	0.805	0.809	0.812
54	0.773	0.777	0.781	0.784	0.788	0.792	0.795	0.799	0.802	0.806
55	0.767	0.77	0.774	0.777	0.781	0.785	0.789	0.792	0.796	0.799
56	0.757	0.761	0.764	0.768	0.772	0.776	0.779	0.783	0.787	0.79
57	0.748	0.751	0.755	0.759	0.762	0.766	0.77	0.774	0.778	0.781
58	0.738	0.742	0.746	0.749	0.753	0.757	0.761	0.765	0.769	0.772
59	0.729	0.733	0.736	0.74	0.744	0.748	0.752	0.756	0.76	0.763
60	0.72	0.724	0.727	0.731	0.735	0.739	0.743	0.747	0.751	0.755
61	0.706	0.709	0.714	0.718	0.722	0.726	0.73	0.734	0.738	0.742
62	0.691	0.696	0.7	0.705	0.709	0.714	0.718	0.721	0.725	0.729
63	0.677	0.682	0.687	0.692	0.697	0.701	0.705	0.709	0.712	0.716
64	0.664	0.668	0.674	0.679	0.684	0.689	0.693	0.696	0.7	0.703
65	0.65	0.655	0.661	0.667	0.672	0.677	0.681	0.684	0.688	0.691
66	0.631	0.636	0.642	0.647	0.653	0.657	0.662	0.665	0.669	0.672
67	0.612	0.617	0.623	0.629	0.634	0.639	0.643	0.647	0.65	0.653
68	0.594	0.599	0.605	0.61	0.616	0.621	0.625	0.629	0.632	0.635
69	0.576	0.581	0.587	0.593	0.598	0.603	0.607	0.611	0.614	0.618

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AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
70	0.559	0.564	0.57	0.576	0.581	0.586	0.59	0.594	0.597	0.601
71	0.532	0.538	0.543	0.549	0.554	0.559	0.564	0.567	0.571	0.574
72	0.507	0.512	0.518	0.523	0.529	0.534	0.538	0.542	0.545	0.549
73	0.483	0.488	0.493	0.499	0.504	0.509	0.514	0.518	0.521	0.524
74	0.461	0.465	0.47	0.476	0.481	0.486	0.491	0.495	0.498	0.501
75	0.439	0.443	0.448	0.454	0.459	0.464	0.469	0.472	0.476	0.479
76	0.406	0.41	0.415	0.42	0.425	0.429	0.434	0.437	0.441	0.445
77	0.375	0.379	0.383	0.388	0.393	0.397	0.401	0.405	0.409	0.413
78	0.346	0.35	0.355	0.359	0.363	0.368	0.371	0.375	0.379	0.383
79	0.32	0.324	0.328	0.332	0.336	0.34	0.344	0.347	0.351	0.355
80	0.296	0.299	0.303	0.307	0.311	0.315	0.318	0.321	0.325	0.33
∞	0	0	0	0	0	0	0	0	0	0

Table A.12: Projections of probabilities of survival, l_x, for males in absence of AIDS in Zimbabwe for the period 2020-2029. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
0	1	1	1	1	1	1	1	1	1	1
1	0.959	0.96	0.961	0.963	0.964	0.963	0.964	0.965	0.966	0.967
2	0.956	0.957	0.959	0.96	0.961	0.961	0.962	0.963	0.964	0.965
3	0.953	0.955	0.956	0.957	0.958	0.958	0.96	0.961	0.962	0.963
4	0.95	0.952	0.953	0.954	0.956	0.956	0.957	0.959	0.96	0.961
5	0.948	0.949	0.95	0.952	0.953	0.954	0.955	0.956	0.957	0.959
6	0.947	0.948	0.949	0.951	0.952	0.953	0.954	0.955	0.957	0.958
7	0.945	0.947	0.948	0.95	0.951	0.952	0.953	0.955	0.956	0.957
8	0.944	0.946	0.947	0.949	0.95	0.951	0.952	0.954	0.955	0.956
9	0.943	0.945	0.946	0.947	0.949	0.95	0.951	0.953	0.954	0.955
10	0.942	0.943	0.945	0.946	0.948	0.949	0.95	0.952	0.953	0.954
11	0.941	0.942	0.944	0.946	0.947	0.948	0.95	0.951	0.952	0.953
12	0.94	0.942	0.943	0.945	0.946	0.947	0.949	0.95	0.951	0.953
13	0.939	0.941	0.942	0.944	0.945	0.947	0.948	0.949	0.951	0.952
14	0.938	0.94	0.941	0.943	0.944	0.946	0.947	0.948	0.95	0.951
15	0.937	0.939	0.94	0.942	0.943	0.945	0.946	0.948	0.949	0.95
16	0.935	0.937	0.939	0.94	0.942	0.943	0.945	0.946	0.947	0.949
17	0.934	0.935	0.937	0.939	0.94	0.942	0.943	0.945	0.946	0.947
18	0.932	0.934	0.935	0.937	0.939	0.94	0.942	0.943	0.944	0.946
19	0.93	0.932	0.934	0.935	0.937	0.939	0.94	0.942	0.943	0.944
20	0.928	0.93	0.932	0.934	0.935	0.937	0.939	0.94	0.942	0.943
21	0.926	0.928	0.93	0.932	0.933	0.935	0.936	0.938	0.939	0.941
22	0.924	0.926	0.927	0.929	0.931	0.933	0.934	0.936	0.937	0.939
23	0.921	0.923	0.925	0.927	0.929	0.93	0.932	0.934	0.935	0.937
24	0.919	0.921	0.923	0.925	0.926	0.928	0.93	0.931	0.933	0.935
25	0.917	0.919	0.92	0.922	0.924	0.926	0.928	0.929	0.931	0.933
26	0.914	0.916	0.918	0.92	0.922	0.924	0.925	0.927	0.929	0.93
27	0.911	0.913	0.915	0.917	0.919	0.921	0.923	0.925	0.926	0.928
28	0.909	0.911	0.913	0.915	0.917	0.919	0.921	0.922	0.924	0.926
29	0.906	0.908	0.911	0.913	0.914	0.916	0.918	0.92	0.922	0.924
30	0.904	0.906	0.908	0.91	0.912	0.914	0.916	0.918	0.92	0.921
31	0.901	0.903	0.905	0.908	0.91	0.912	0.914	0.915	0.917	0.919
32	0.898	0.901	0.903	0.905	0.907	0.909	0.911	0.913	0.915	0.917
33	0.896	0.898	0.9	0.902	0.905	0.907	0.909	0.911	0.913	0.915

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AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
34	0.893	0.895	0.898	0.9	0.902	0.904	0.906	0.908	0.91	0.912
35	0.89	0.893	0.895	0.897	0.9	0.902	0.904	0.906	0.908	0.91
36	0.888	0.89	0.892	0.895	0.897	0.899	0.901	0.903	0.905	0.907
37	0.885	0.887	0.889	0.892	0.894	0.896	0.898	0.901	0.903	0.905
38	0.882	0.884	0.887	0.889	0.891	0.893	0.896	0.898	0.9	0.902
39	0.879	0.881	0.884	0.886	0.888	0.891	0.893	0.895	0.897	0.9
40	0.876	0.878	0.881	0.883	0.886	0.888	0.89	0.893	0.895	0.897
41	0.872	0.875	0.877	0.88	0.882	0.885	0.887	0.889	0.892	0.894
42	0.869	0.872	0.874	0.877	0.879	0.881	0.884	0.886	0.889	0.891
43	0.865	0.868	0.871	0.873	0.876	0.878	0.881	0.883	0.885	0.888
44	0.862	0.865	0.867	0.87	0.873	0.875	0.877	0.88	0.882	0.885
45	0.858	0.861	0.864	0.867	0.869	0.872	0.874	0.877	0.879	0.881
46	0.854	0.857	0.859	0.862	0.865	0.867	0.87	0.872	0.875	0.877
47	0.849	0.852	0.855	0.858	0.86	0.863	0.865	0.868	0.87	0.873
48	0.844	0.847	0.85	0.853	0.856	0.858	0.861	0.864	0.866	0.869
49	0.84	0.843	0.846	0.849	0.851	0.854	0.857	0.859	0.862	0.864
50	0.835	0.838	0.841	0.844	0.847	0.85	0.852	0.855	0.858	0.86
51	0.829	0.832	0.835	0.838	0.841	0.843	0.846	0.849	0.851	0.854
52	0.822	0.825	0.828	0.831	0.834	0.837	0.84	0.842	0.845	0.848
53	0.816	0.819	0.822	0.825	0.828	0.831	0.834	0.836	0.839	0.842
54	0.809	0.812	0.816	0.819	0.822	0.825	0.827	0.83	0.833	0.835
55	0.803	0.806	0.809	0.812	0.815	0.818	0.821	0.824	0.827	0.829
56	0.794	0.797	0.8	0.803	0.806	0.809	0.812	0.815	0.818	0.821
57	0.785	0.788	0.791	0.794	0.798	0.801	0.804	0.807	0.809	0.812
58	0.776	0.779	0.782	0.786	0.789	0.792	0.795	0.798	0.801	0.804
59	0.767	0.77	0.774	0.777	0.78	0.783	0.786	0.789	0.792	0.795
60	0.758	0.762	0.765	0.768	0.772	0.775	0.778	0.781	0.784	0.787
61	0.745	0.749	0.752	0.755	0.759	0.762	0.765	0.768	0.771	0.774
62	0.732	0.736	0.739	0.743	0.746	0.749	0.753	0.756	0.759	0.761
63	0.719	0.723	0.727	0.73	0.734	0.737	0.74	0.743	0.746	0.749
64	0.707	0.71	0.714	0.718	0.721	0.725	0.728	0.731	0.734	0.737
65	0.694	0.698	0.702	0.706	0.709	0.713	0.716	0.719	0.722	0.725
66	0.675	0.679	0.683	0.686	0.69	0.694	0.697	0.7	0.703	0.706
67	0.657	0.66	0.664	0.668	0.671	0.675	0.678	0.681	0.684	0.687
68	0.639	0.642	0.646	0.649	0.653	0.657	0.66	0.663	0.667	0.669
69	0.621	0.624	0.628	0.632	0.636	0.639	0.643	0.646	0.649	0.652

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AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
70	0.604	0.607	0.611	0.615	0.618	0.622	0.626	0.629	0.632	0.635
71	0.577	0.581	0.585	0.588	0.592	0.596	0.599	0.602	0.606	0.609
72	0.552	0.556	0.559	0.563	0.567	0.571	0.574	0.577	0.58	0.583
73	0.528	0.531	0.535	0.539	0.543	0.546	0.55	0.553	0.556	0.559
74	0.505	0.508	0.512	0.516	0.52	0.523	0.526	0.529	0.532	0.535
75	0.482	0.486	0.49	0.494	0.498	0.501	0.504	0.507	0.51	0.513
76	0.448	0.453	0.457	0.461	0.465	0.468	0.471	0.474	0.476	0.479
77	0.417	0.421	0.426	0.43	0.434	0.437	0.44	0.442	0.445	0.447
78	0.387	0.392	0.397	0.401	0.405	0.408	0.411	0.413	0.415	0.417
79	0.36	0.365	0.37	0.374	0.378	0.381	0.384	0.386	0.387	0.389
80	0.335	0.34	0.345	0.349	0.353	0.356	0.358	0.36	0.362	0.363
∞	0	0	0	0	0	0	0	0	0	0

Table A.13: Projections of probabilities of survival, l_x, for males in absence of AIDS in Zimbabwe for the period 2030-2039. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
0	1	1	1	1	1	1	1	1	1	1
1	0.967	0.968	0.969	0.969	0.97	0.97	0.971	0.971	0.972	0.973
2	0.965	0.966	0.967	0.968	0.969	0.969	0.969	0.97	0.971	0.971
3	0.963	0.964	0.965	0.966	0.967	0.967	0.968	0.969	0.969	0.97
4	0.961	0.962	0.963	0.964	0.965	0.966	0.966	0.967	0.968	0.968
5	0.96	0.961	0.962	0.962	0.963	0.964	0.965	0.966	0.966	0.967
6	0.959	0.96	0.961	0.962	0.963	0.963	0.964	0.965	0.966	0.966
7	0.958	0.959	0.96	0.961	0.962	0.963	0.963	0.964	0.965	0.966
8	0.957	0.958	0.959	0.96	0.961	0.962	0.963	0.964	0.964	0.965
9	0.956	0.957	0.959	0.96	0.96	0.961	0.962	0.963	0.964	0.964
10	0.955	0.957	0.958	0.959	0.96	0.961	0.961	0.962	0.963	0.964
11	0.955	0.956	0.957	0.958	0.959	0.96	0.961	0.962	0.962	0.963
12	0.954	0.955	0.956	0.957	0.958	0.959	0.96	0.961	0.962	0.962
13	0.953	0.954	0.955	0.957	0.958	0.958	0.959	0.96	0.961	0.962
14	0.952	0.954	0.955	0.956	0.957	0.958	0.959	0.959	0.96	0.961
15	0.952	0.953	0.954	0.955	0.956	0.957	0.958	0.959	0.96	0.96
16	0.95	0.951	0.953	0.954	0.955	0.956	0.957	0.958	0.958	0.959
17	0.949	0.95	0.951	0.952	0.953	0.954	0.955	0.956	0.957	0.958
18	0.947	0.949	0.95	0.951	0.952	0.953	0.954	0.955	0.956	0.957
19	0.946	0.947	0.948	0.95	0.951	0.952	0.953	0.954	0.955	0.956
20	0.944	0.946	0.947	0.948	0.949	0.951	0.952	0.953	0.953	0.954
21	0.942	0.944	0.945	0.946	0.948	0.949	0.95	0.951	0.952	0.953
22	0.94	0.942	0.943	0.944	0.946	0.947	0.948	0.949	0.95	0.951
23	0.938	0.94	0.941	0.942	0.944	0.945	0.946	0.947	0.948	0.949
24	0.936	0.938	0.939	0.941	0.942	0.943	0.944	0.945	0.946	0.947
25	0.934	0.936	0.937	0.939	0.94	0.941	0.942	0.943	0.945	0.946
26	0.932	0.934	0.935	0.937	0.938	0.939	0.94	0.941	0.943	0.944
27	0.93	0.931	0.933	0.934	0.936	0.937	0.938	0.94	0.941	0.942
28	0.928	0.929	0.931	0.932	0.934	0.935	0.936	0.938	0.939	0.94
29	0.925	0.927	0.929	0.93	0.932	0.933	0.934	0.936	0.937	0.938
30	0.923	0.925	0.927	0.928	0.93	0.931	0.932	0.934	0.935	0.936
31	0.921	0.923	0.924	0.926	0.927	0.929	0.93	0.932	0.933	0.934
32	0.919	0.92	0.922	0.924	0.925	0.927	0.928	0.93	0.931	0.932
33	0.916	0.918	0.92	0.922	0.923	0.925	0.926	0.928	0.929	0.93

Continued on next page

AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
34	0.914	0.916	0.918	0.919	0.921	0.923	0.924	0.925	0.927	0.928
35	0.912	0.914	0.916	0.917	0.919	0.92	0.922	0.923	0.925	0.926
36	0.909	0.911	0.913	0.915	0.916	0.918	0.92	0.921	0.923	0.924
37	0.907	0.909	0.911	0.912	0.914	0.916	0.917	0.919	0.92	0.922
38	0.904	0.906	0.908	0.91	0.912	0.913	0.915	0.916	0.918	0.92
39	0.902	0.904	0.906	0.907	0.909	0.911	0.913	0.914	0.916	0.917
40	0.899	0.901	0.903	0.905	0.907	0.909	0.91	0.912	0.913	0.915
41	0.896	0.898	0.9	0.902	0.904	0.906	0.907	0.909	0.911	0.912
42	0.893	0.895	0.897	0.899	0.901	0.903	0.905	0.906	0.908	0.909
43	0.89	0.892	0.894	0.896	0.898	0.9	0.902	0.903	0.905	0.907
44	0.887	0.889	0.891	0.893	0.895	0.897	0.899	0.901	0.902	0.904
45	0.884	0.886	0.888	0.89	0.892	0.894	0.896	0.898	0.9	0.901
46	0.879	0.882	0.884	0.886	0.888	0.89	0.892	0.894	0.896	0.897
47	0.875	0.877	0.88	0.882	0.884	0.886	0.888	0.89	0.892	0.893
48	0.871	0.873	0.876	0.878	0.88	0.882	0.884	0.886	0.888	0.89
49	0.867	0.869	0.871	0.874	0.876	0.878	0.88	0.882	0.884	0.886
50	0.862	0.865	0.867	0.87	0.872	0.874	0.876	0.878	0.88	0.882
51	0.856	0.859	0.861	0.863	0.866	0.868	0.87	0.872	0.874	0.876
52	0.85	0.853	0.855	0.857	0.86	0.862	0.864	0.866	0.868	0.87
53	0.844	0.847	0.849	0.852	0.854	0.856	0.858	0.861	0.863	0.865
54	0.838	0.841	0.843	0.846	0.848	0.85	0.853	0.855	0.857	0.859
55	0.832	0.835	0.837	0.84	0.842	0.845	0.847	0.849	0.851	0.854
56	0.823	0.826	0.829	0.831	0.834	0.836	0.839	0.841	0.843	0.845
57	0.815	0.818	0.82	0.823	0.825	0.828	0.83	0.833	0.835	0.837
58	0.806	0.809	0.812	0.814	0.817	0.82	0.822	0.825	0.827	0.829
59	0.798	0.801	0.804	0.806	0.809	0.812	0.814	0.817	0.819	0.822
60	0.79	0.793	0.795	0.798	0.801	0.804	0.806	0.809	0.811	0.814
61	0.777	0.78	0.783	0.785	0.788	0.791	0.794	0.796	0.799	0.802
62	0.764	0.767	0.77	0.773	0.776	0.779	0.782	0.784	0.787	0.79
63	0.752	0.755	0.758	0.761	0.764	0.767	0.769	0.772	0.775	0.778
64	0.74	0.743	0.746	0.749	0.752	0.755	0.758	0.761	0.763	0.766
65	0.728	0.731	0.734	0.737	0.74	0.743	0.746	0.749	0.752	0.755
66	0.709	0.712	0.715	0.718	0.721	0.724	0.727	0.731	0.734	0.737
67	0.69	0.693	0.697	0.7	0.703	0.706	0.709	0.713	0.716	0.719
68	0.672	0.676	0.679	0.682	0.685	0.689	0.692	0.695	0.698	0.701
69	0.655	0.658	0.661	0.665	0.668	0.671	0.675	0.678	0.681	0.684

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AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
70	0.638	0.641	0.644	0.648	0.651	0.655	0.658	0.662	0.665	0.668
71	0.612	0.615	0.618	0.621	0.625	0.628	0.632	0.635	0.639	0.642
72	0.586	0.589	0.593	0.596	0.6	0.603	0.607	0.61	0.614	0.617
73	0.562	0.565	0.568	0.572	0.575	0.579	0.583	0.586	0.589	0.593
74	0.539	0.542	0.545	0.549	0.552	0.556	0.559	0.563	0.566	0.57
75	0.516	0.519	0.523	0.526	0.53	0.534	0.537	0.541	0.544	0.547
76	0.481	0.484	0.487	0.491	0.494	0.498	0.502	0.505	0.509	0.512
77	0.449	0.452	0.454	0.458	0.461	0.465	0.469	0.472	0.476	0.48
78	0.419	0.421	0.424	0.427	0.43	0.434	0.438	0.442	0.445	0.449
79	0.391	0.393	0.395	0.398	0.401	0.405	0.409	0.413	0.417	0.42
80	0.364	0.366	0.368	0.371	0.374	0.378	0.382	0.386	0.39	0.394
∞	0	0	0	0	0	0	0	0	0	0

Table A.14: Projections of probabilities of survival, l_x, for males in absence of AIDS in Zimbabwe for the period 2040-2050. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
0	1	1	1	1	1	1	1	1	1	1	1
1	0.973	0.973	0.974	0.975	0.975	0.975	0.976	0.976	0.977	0.978	0.978
2	0.971	0.972	0.973	0.973	0.974	0.974	0.975	0.975	0.976	0.977	0.977
3	0.97	0.971	0.972	0.972	0.973	0.973	0.974	0.974	0.975	0.975	0.976
4	0.969	0.97	0.97	0.971	0.972	0.972	0.973	0.973	0.974	0.974	0.975
5	0.968	0.968	0.969	0.97	0.97	0.971	0.972	0.972	0.973	0.973	0.974
6	0.967	0.968	0.968	0.969	0.97	0.97	0.971	0.972	0.972	0.973	0.973
7	0.966	0.967	0.968	0.968	0.969	0.97	0.97	0.971	0.972	0.972	0.973
8	0.966	0.967	0.967	0.968	0.969	0.969	0.97	0.971	0.971	0.972	0.972
9	0.965	0.966	0.967	0.967	0.968	0.969	0.969	0.97	0.971	0.971	0.972
10	0.965	0.965	0.966	0.967	0.967	0.968	0.969	0.97	0.97	0.971	0.971
11	0.964	0.965	0.965	0.966	0.967	0.968	0.968	0.969	0.97	0.97	0.971
12	0.963	0.964	0.965	0.966	0.966	0.967	0.968	0.968	0.969	0.97	0.97
13	0.963	0.963	0.964	0.965	0.966	0.966	0.967	0.968	0.969	0.969	0.97
14	0.962	0.963	0.964	0.964	0.965	0.966	0.967	0.967	0.968	0.969	0.969
15	0.961	0.962	0.963	0.964	0.965	0.965	0.966	0.967	0.967	0.968	0.969
16	0.96	0.961	0.962	0.963	0.963	0.964	0.965	0.966	0.966	0.967	0.968
17	0.959	0.96	0.961	0.961	0.962	0.963	0.964	0.965	0.965	0.966	0.967
18	0.958	0.959	0.959	0.96	0.961	0.962	0.963	0.964	0.964	0.965	0.966
19	0.957	0.957	0.958	0.959	0.96	0.961	0.962	0.962	0.963	0.964	0.965
20	0.955	0.956	0.957	0.958	0.959	0.96	0.961	0.961	0.962	0.963	0.964
21	0.954	0.955	0.955	0.956	0.957	0.958	0.959	0.96	0.961	0.962	0.962
22	0.952	0.953	0.954	0.955	0.956	0.957	0.957	0.958	0.959	0.96	0.961
23	0.95	0.951	0.952	0.953	0.954	0.955	0.956	0.957	0.958	0.959	0.959
24	0.948	0.949	0.95	0.951	0.952	0.953	0.954	0.955	0.956	0.957	0.958
25	0.947	0.948	0.949	0.95	0.951	0.952	0.953	0.954	0.955	0.956	0.956
26	0.945	0.946	0.947	0.948	0.949	0.95	0.951	0.952	0.953	0.954	0.955
27	0.943	0.944	0.945	0.946	0.947	0.948	0.949	0.95	0.951	0.952	0.953
28	0.941	0.942	0.943	0.945	0.946	0.947	0.948	0.949	0.95	0.951	0.952
29	0.939	0.94	0.942	0.943	0.944	0.945	0.946	0.947	0.948	0.949	0.95
30	0.937	0.939	0.94	0.941	0.942	0.943	0.944	0.945	0.946	0.948	0.949
31	0.935	0.937	0.938	0.939	0.94	0.941	0.943	0.944	0.945	0.946	0.947
32	0.934	0.935	0.936	0.937	0.938	0.94	0.941	0.942	0.943	0.944	0.945
33	0.932	0.933	0.934	0.935	0.937	0.938	0.939	0.94	0.941	0.942	0.944

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AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
34	0.93	0.931	0.932	0.934	0.935	0.936	0.937	0.938	0.94	0.941	0.942
35	0.928	0.929	0.93	0.932	0.933	0.934	0.935	0.937	0.938	0.939	0.94
36	0.925	0.927	0.928	0.93	0.931	0.932	0.933	0.935	0.936	0.937	0.938
37	0.923	0.925	0.926	0.927	0.929	0.93	0.931	0.933	0.934	0.935	0.936
38	0.921	0.922	0.924	0.925	0.927	0.928	0.929	0.931	0.932	0.933	0.934
39	0.919	0.92	0.922	0.923	0.925	0.926	0.927	0.929	0.93	0.931	0.932
40	0.917	0.918	0.92	0.921	0.923	0.924	0.925	0.927	0.928	0.929	0.931
41	0.914	0.915	0.917	0.918	0.92	0.921	0.923	0.924	0.925	0.927	0.928
42	0.911	0.913	0.914	0.916	0.917	0.919	0.92	0.922	0.923	0.924	0.926
43	0.908	0.91	0.912	0.913	0.915	0.916	0.918	0.919	0.92	0.922	0.923
44	0.906	0.907	0.909	0.911	0.912	0.914	0.915	0.917	0.918	0.919	0.921
45	0.903	0.905	0.906	0.908	0.91	0.911	0.913	0.914	0.916	0.917	0.919
46	0.899	0.901	0.902	0.904	0.906	0.907	0.909	0.91	0.912	0.914	0.915
47	0.895	0.897	0.899	0.9	0.902	0.904	0.905	0.907	0.908	0.91	0.912
48	0.891	0.893	0.895	0.897	0.898	0.9	0.902	0.903	0.905	0.907	0.908
49	0.888	0.889	0.891	0.893	0.895	0.896	0.898	0.9	0.901	0.903	0.905
50	0.884	0.886	0.887	0.889	0.891	0.893	0.895	0.896	0.898	0.9	0.901
51	0.878	0.88	0.882	0.884	0.886	0.887	0.889	0.891	0.893	0.894	0.896
52	0.872	0.874	0.876	0.878	0.88	0.882	0.884	0.885	0.887	0.889	0.891
53	0.867	0.869	0.871	0.873	0.875	0.877	0.878	0.88	0.882	0.884	0.885
54	0.861	0.863	0.865	0.867	0.869	0.871	0.873	0.875	0.877	0.878	0.88
55	0.856	0.858	0.86	0.862	0.864	0.866	0.868	0.87	0.871	0.873	0.875
56	0.848	0.85	0.852	0.854	0.856	0.858	0.86	0.862	0.864	0.866	0.868
57	0.84	0.842	0.844	0.846	0.848	0.85	0.852	0.854	0.856	0.858	0.86
58	0.832	0.834	0.836	0.838	0.841	0.843	0.845	0.847	0.849	0.851	0.853
59	0.824	0.826	0.828	0.831	0.833	0.835	0.837	0.839	0.841	0.843	0.845
60	0.816	0.819	0.821	0.823	0.825	0.828	0.83	0.832	0.834	0.836	0.838
61	0.804	0.807	0.809	0.811	0.814	0.816	0.818	0.82	0.822	0.824	0.826
62	0.792	0.795	0.797	0.8	0.802	0.805	0.807	0.809	0.811	0.813	0.815
63	0.78	0.783	0.786	0.788	0.791	0.793	0.796	0.798	0.8	0.802	0.804
64	0.769	0.772	0.774	0.777	0.78	0.782	0.784	0.787	0.789	0.79	0.792
65	0.758	0.76	0.763	0.766	0.769	0.771	0.773	0.776	0.778	0.78	0.781
66	0.739	0.742	0.745	0.748	0.751	0.753	0.756	0.758	0.76	0.762	0.764
67	0.722	0.725	0.727	0.73	0.733	0.736	0.738	0.741	0.743	0.745	0.747
68	0.704	0.707	0.71	0.713	0.716	0.719	0.721	0.724	0.726	0.728	0.73
69	0.687	0.69	0.693	0.696	0.699	0.702	0.705	0.707	0.709	0.711	0.713

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AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
70	0.671	0.674	0.677	0.68	0.683	0.686	0.688	0.691	0.693	0.695	0.697
71	0.645	0.648	0.651	0.654	0.657	0.66	0.663	0.665	0.668	0.67	0.672
72	0.62	0.623	0.626	0.629	0.633	0.635	0.638	0.641	0.643	0.645	0.648
73	0.596	0.599	0.602	0.606	0.609	0.612	0.614	0.617	0.62	0.622	0.624
74	0.573	0.576	0.58	0.583	0.586	0.589	0.591	0.594	0.597	0.599	0.602
75	0.551	0.554	0.557	0.561	0.564	0.567	0.569	0.572	0.575	0.577	0.58
76	0.516	0.519	0.523	0.526	0.529	0.532	0.535	0.537	0.54	0.542	0.545
77	0.483	0.487	0.49	0.493	0.496	0.499	0.502	0.504	0.507	0.51	0.512
78	0.453	0.456	0.46	0.463	0.466	0.469	0.471	0.474	0.476	0.479	0.481
79	0.424	0.428	0.431	0.434	0.437	0.44	0.442	0.445	0.447	0.45	0.452
80	0.397	0.401	0.404	0.407	0.41	0.413	0.415	0.418	0.42	0.422	0.425
∞	0	0	0	0	0	0	0	0	0	0	0

Table A.15: Estimates of probabilities of survival, l_x, for females in absence of AIDS in Zimbabwe for the period 1980-1989. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	1	1	1	1	1	1	1	1	1	1
1	0.909	0.913	0.917	0.921	0.924	0.927	0.931	0.935	0.94	0.946
2	0.905	0.91	0.913	0.917	0.92	0.923	0.927	0.931	0.936	0.942
3	0.902	0.906	0.91	0.913	0.916	0.919	0.923	0.927	0.932	0.938
4	0.898	0.902	0.906	0.909	0.912	0.916	0.919	0.923	0.928	0.934
5	0.894	0.898	0.902	0.906	0.909	0.912	0.915	0.919	0.924	0.93
6	0.892	0.896	0.9	0.903	0.906	0.91	0.913	0.917	0.923	0.929
7	0.889	0.893	0.897	0.901	0.904	0.907	0.911	0.915	0.921	0.927
8	0.887	0.891	0.895	0.899	0.902	0.905	0.909	0.913	0.919	0.925
9	0.884	0.888	0.893	0.896	0.9	0.903	0.907	0.911	0.917	0.924
10	0.882	0.886	0.89	0.894	0.897	0.901	0.905	0.91	0.915	0.922
11	0.88	0.884	0.888	0.892	0.896	0.899	0.903	0.908	0.914	0.921
12	0.878	0.882	0.887	0.89	0.894	0.898	0.902	0.907	0.913	0.92
13	0.876	0.881	0.885	0.889	0.892	0.896	0.9	0.905	0.911	0.918
14	0.874	0.879	0.883	0.887	0.891	0.894	0.898	0.903	0.91	0.917
15	0.872	0.877	0.881	0.885	0.889	0.893	0.897	0.902	0.908	0.916
16	0.87	0.875	0.879	0.883	0.887	0.891	0.895	0.9	0.907	0.914
17	0.868	0.873	0.877	0.881	0.885	0.889	0.893	0.898	0.905	0.913
18	0.866	0.871	0.875	0.879	0.883	0.887	0.891	0.897	0.903	0.911
19	0.864	0.869	0.873	0.877	0.881	0.885	0.889	0.895	0.902	0.91
20	0.862	0.867	0.871	0.875	0.879	0.883	0.888	0.893	0.9	0.908
21	0.859	0.864	0.869	0.873	0.877	0.881	0.885	0.891	0.898	0.906
22	0.857	0.862	0.866	0.87	0.874	0.878	0.883	0.889	0.896	0.904
23	0.854	0.859	0.864	0.868	0.872	0.876	0.881	0.886	0.894	0.902
24	0.852	0.857	0.861	0.865	0.869	0.874	0.878	0.884	0.892	0.9
25	0.849	0.854	0.859	0.863	0.867	0.871	0.876	0.882	0.889	0.898
26	0.846	0.851	0.856	0.86	0.864	0.868	0.873	0.879	0.887	0.896
27	0.843	0.848	0.853	0.857	0.861	0.866	0.871	0.877	0.885	0.894
28	0.84	0.845	0.85	0.854	0.858	0.863	0.868	0.874	0.882	0.891
29	0.837	0.842	0.847	0.851	0.856	0.86	0.865	0.872	0.88	0.889
30	0.834	0.839	0.844	0.849	0.853	0.857	0.863	0.869	0.877	0.887
31	0.831	0.836	0.841	0.845	0.85	0.854	0.86	0.866	0.874	0.884
32	0.827	0.833	0.838	0.842	0.847	0.851	0.857	0.863	0.872	0.881
33	0.824	0.829	0.835	0.839	0.844	0.848	0.854	0.861	0.869	0.879

Continued on next page

AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
34	0.821	0.826	0.831	0.836	0.841	0.845	0.851	0.858	0.866	0.876
35	0.817	0.823	0.828	0.833	0.838	0.842	0.848	0.855	0.864	0.874
36	0.814	0.819	0.824	0.829	0.834	0.839	0.844	0.852	0.861	0.871
37	0.81	0.816	0.821	0.825	0.83	0.835	0.841	0.848	0.857	0.868
38	0.807	0.812	0.817	0.821	0.826	0.831	0.837	0.845	0.854	0.865
39	0.803	0.809	0.813	0.817	0.822	0.827	0.833	0.841	0.851	0.862
40	0.8	0.805	0.809	0.814	0.818	0.823	0.83	0.838	0.848	0.859
41	0.795	0.801	0.805	0.809	0.814	0.819	0.826	0.834	0.844	0.856
42	0.791	0.796	0.801	0.805	0.81	0.815	0.822	0.83	0.84	0.852
43	0.786	0.792	0.797	0.801	0.806	0.811	0.818	0.826	0.836	0.848
44	0.782	0.787	0.792	0.797	0.802	0.807	0.814	0.822	0.832	0.844
45	0.777	0.783	0.788	0.793	0.798	0.803	0.81	0.818	0.828	0.84
46	0.772	0.778	0.783	0.788	0.793	0.798	0.805	0.813	0.824	0.836
47	0.767	0.773	0.778	0.783	0.788	0.793	0.8	0.808	0.819	0.831
48	0.762	0.768	0.773	0.778	0.783	0.788	0.795	0.803	0.814	0.827
49	0.757	0.763	0.768	0.773	0.777	0.783	0.79	0.798	0.809	0.822
50	0.752	0.758	0.763	0.768	0.772	0.778	0.785	0.794	0.805	0.818
51	0.745	0.751	0.756	0.761	0.766	0.772	0.779	0.787	0.799	0.812
52	0.739	0.745	0.75	0.755	0.76	0.765	0.772	0.781	0.792	0.806
53	0.732	0.738	0.743	0.748	0.753	0.759	0.766	0.775	0.786	0.8
54	0.726	0.732	0.737	0.742	0.747	0.753	0.76	0.769	0.78	0.794
55	0.719	0.725	0.731	0.735	0.741	0.746	0.754	0.763	0.774	0.788
56	0.71	0.716	0.722	0.727	0.732	0.738	0.745	0.754	0.766	0.78
57	0.702	0.708	0.713	0.718	0.723	0.729	0.737	0.746	0.758	0.772
58	0.693	0.699	0.705	0.71	0.715	0.721	0.728	0.738	0.75	0.764
59	0.684	0.69	0.696	0.701	0.707	0.713	0.72	0.73	0.742	0.756
60	0.676	0.682	0.688	0.693	0.698	0.704	0.712	0.722	0.734	0.748
61	0.664	0.67	0.675	0.68	0.685	0.692	0.699	0.709	0.722	0.737
62	0.652	0.657	0.663	0.668	0.673	0.679	0.687	0.697	0.71	0.725
63	0.64	0.645	0.65	0.655	0.66	0.667	0.675	0.685	0.699	0.714
64	0.628	0.634	0.638	0.643	0.648	0.655	0.663	0.674	0.687	0.703
65	0.617	0.622	0.627	0.631	0.636	0.643	0.651	0.662	0.676	0.692
66	0.598	0.603	0.608	0.613	0.618	0.625	0.633	0.644	0.658	0.674
67	0.58	0.585	0.59	0.595	0.6	0.607	0.615	0.627	0.641	0.657
68	0.562	0.568	0.573	0.578	0.583	0.59	0.598	0.609	0.624	0.64
69	0.545	0.551	0.556	0.561	0.566	0.573	0.582	0.593	0.607	0.623

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AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
70	0.529	0.534	0.54	0.545	0.55	0.557	0.565	0.577	0.591	0.607
71	0.504	0.51	0.515	0.52	0.525	0.531	0.54	0.551	0.565	0.582
72	0.481	0.486	0.491	0.496	0.501	0.507	0.516	0.527	0.541	0.558
73	0.459	0.464	0.469	0.473	0.478	0.484	0.492	0.504	0.518	0.535
74	0.438	0.443	0.447	0.451	0.456	0.462	0.47	0.481	0.496	0.512
75	0.418	0.422	0.426	0.43	0.435	0.441	0.449	0.46	0.474	0.491
76	0.383	0.388	0.393	0.397	0.402	0.408	0.416	0.427	0.44	0.456
77	0.351	0.357	0.361	0.366	0.371	0.377	0.386	0.396	0.409	0.424
78	0.322	0.328	0.333	0.338	0.343	0.349	0.357	0.367	0.38	0.394
79	0.295	0.301	0.306	0.311	0.317	0.323	0.331	0.341	0.353	0.366
80	0.271	0.276	0.282	0.287	0.293	0.299	0.307	0.316	0.327	0.34
∞	0	0	0	0	0	0	0	0	0	0

Table A.16: Estimates of probabilities of survival, l_x, for females in absence of AIDS in Zimbabwe for the period 1990-1999. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	1	1	1	1	1	1	1	1	1	1
1	0.952	0.958	0.963	0.966	0.967	0.966	0.965	0.963	0.961	0.959
2	0.948	0.954	0.959	0.962	0.963	0.962	0.961	0.959	0.957	0.955
3	0.944	0.95	0.955	0.958	0.959	0.958	0.957	0.955	0.953	0.951
4	0.94	0.946	0.951	0.954	0.955	0.954	0.953	0.951	0.949	0.947
5	0.936	0.942	0.947	0.95	0.951	0.95	0.949	0.947	0.945	0.943
6	0.935	0.941	0.946	0.949	0.95	0.949	0.948	0.946	0.944	0.942
7	0.934	0.94	0.945	0.948	0.949	0.948	0.947	0.944	0.942	0.94
8	0.932	0.938	0.943	0.947	0.948	0.947	0.945	0.943	0.941	0.939
9	0.931	0.937	0.942	0.946	0.947	0.946	0.944	0.942	0.94	0.938
10	0.929	0.936	0.941	0.944	0.946	0.945	0.943	0.941	0.939	0.936
11	0.928	0.935	0.94	0.944	0.945	0.944	0.942	0.94	0.938	0.935
12	0.927	0.934	0.939	0.943	0.944	0.943	0.941	0.939	0.937	0.934
13	0.926	0.933	0.938	0.942	0.943	0.942	0.941	0.938	0.936	0.933
14	0.925	0.932	0.937	0.941	0.942	0.941	0.94	0.937	0.935	0.932
15	0.924	0.931	0.937	0.94	0.941	0.941	0.939	0.936	0.934	0.931
16	0.922	0.929	0.935	0.939	0.94	0.939	0.937	0.935	0.932	0.93
17	0.921	0.928	0.934	0.938	0.939	0.938	0.936	0.934	0.931	0.928
18	0.919	0.927	0.933	0.936	0.938	0.937	0.935	0.932	0.93	0.927
19	0.918	0.925	0.932	0.935	0.936	0.936	0.934	0.931	0.928	0.926
20	0.916	0.924	0.93	0.934	0.935	0.935	0.933	0.93	0.927	0.925
21	0.915	0.922	0.929	0.932	0.934	0.933	0.931	0.928	0.925	0.923
22	0.913	0.921	0.927	0.931	0.932	0.931	0.929	0.926	0.924	0.921
23	0.911	0.919	0.925	0.929	0.93	0.93	0.928	0.925	0.922	0.919
24	0.909	0.917	0.924	0.928	0.929	0.928	0.926	0.923	0.92	0.917
25	0.907	0.915	0.922	0.926	0.927	0.926	0.924	0.921	0.918	0.916
26	0.905	0.913	0.92	0.924	0.925	0.924	0.922	0.919	0.916	0.914
27	0.903	0.911	0.918	0.922	0.923	0.923	0.92	0.917	0.914	0.911
28	0.901	0.909	0.916	0.92	0.922	0.921	0.918	0.915	0.912	0.909
29	0.898	0.907	0.914	0.918	0.92	0.919	0.916	0.913	0.91	0.907
30	0.896	0.905	0.912	0.916	0.918	0.917	0.914	0.911	0.908	0.905
31	0.894	0.903	0.91	0.914	0.916	0.915	0.912	0.909	0.906	0.903
32	0.891	0.901	0.908	0.912	0.914	0.913	0.91	0.907	0.904	0.901
33	0.889	0.898	0.906	0.91	0.912	0.911	0.908	0.905	0.901	0.898

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AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
34	0.887	0.896	0.904	0.908	0.91	0.909	0.906	0.903	0.899	0.896
35	0.884	0.894	0.902	0.906	0.908	0.907	0.904	0.901	0.897	0.894
36	0.882	0.891	0.899	0.904	0.905	0.904	0.901	0.898	0.894	0.891
37	0.879	0.889	0.897	0.901	0.903	0.902	0.899	0.895	0.892	0.888
38	0.876	0.886	0.894	0.899	0.9	0.899	0.896	0.893	0.889	0.886
39	0.874	0.884	0.892	0.896	0.898	0.897	0.894	0.89	0.887	0.883
40	0.871	0.881	0.889	0.894	0.895	0.894	0.891	0.888	0.884	0.881
41	0.867	0.878	0.886	0.891	0.892	0.891	0.888	0.885	0.881	0.877
42	0.864	0.874	0.883	0.888	0.889	0.888	0.885	0.881	0.878	0.874
43	0.86	0.871	0.88	0.885	0.886	0.885	0.882	0.878	0.874	0.871
44	0.856	0.868	0.876	0.882	0.883	0.882	0.879	0.875	0.871	0.867
45	0.853	0.864	0.873	0.879	0.88	0.879	0.876	0.872	0.868	0.864
46	0.848	0.86	0.869	0.875	0.876	0.875	0.872	0.868	0.864	0.86
47	0.844	0.856	0.865	0.871	0.872	0.871	0.868	0.864	0.86	0.855
48	0.84	0.852	0.861	0.867	0.868	0.867	0.864	0.86	0.855	0.851
49	0.835	0.847	0.857	0.863	0.864	0.863	0.86	0.856	0.851	0.847
50	0.831	0.843	0.853	0.859	0.86	0.859	0.856	0.852	0.847	0.843
51	0.825	0.837	0.847	0.853	0.855	0.854	0.851	0.846	0.842	0.837
52	0.819	0.832	0.842	0.848	0.85	0.848	0.845	0.841	0.836	0.832
53	0.813	0.826	0.836	0.842	0.844	0.843	0.84	0.835	0.83	0.826
54	0.808	0.821	0.831	0.837	0.839	0.838	0.834	0.83	0.825	0.82
55	0.802	0.815	0.825	0.832	0.834	0.832	0.829	0.824	0.819	0.815
56	0.794	0.807	0.818	0.824	0.826	0.825	0.821	0.817	0.812	0.807
57	0.786	0.8	0.81	0.817	0.819	0.817	0.814	0.809	0.804	0.799
58	0.779	0.792	0.803	0.809	0.811	0.81	0.806	0.801	0.796	0.792
59	0.771	0.785	0.796	0.802	0.804	0.803	0.799	0.794	0.789	0.784
60	0.763	0.777	0.788	0.795	0.797	0.795	0.792	0.787	0.781	0.777
61	0.752	0.766	0.777	0.784	0.786	0.784	0.78	0.775	0.77	0.765
62	0.741	0.755	0.766	0.773	0.775	0.773	0.769	0.764	0.759	0.754
63	0.73	0.744	0.756	0.762	0.764	0.762	0.758	0.753	0.747	0.742
64	0.719	0.734	0.745	0.752	0.754	0.752	0.748	0.742	0.736	0.731
65	0.708	0.723	0.735	0.741	0.743	0.741	0.737	0.731	0.726	0.72
66	0.691	0.706	0.717	0.724	0.726	0.724	0.72	0.714	0.708	0.703
67	0.674	0.689	0.701	0.708	0.709	0.707	0.703	0.697	0.691	0.686
68	0.657	0.672	0.684	0.691	0.693	0.691	0.686	0.68	0.674	0.669
69	0.64	0.656	0.668	0.675	0.677	0.675	0.67	0.664	0.658	0.653

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AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
70	0.625	0.64	0.653	0.66	0.661	0.659	0.654	0.648	0.642	0.637
71	0.599	0.615	0.627	0.634	0.636	0.634	0.629	0.623	0.617	0.611
72	0.575	0.591	0.603	0.61	0.612	0.609	0.605	0.598	0.592	0.587
73	0.552	0.568	0.58	0.587	0.588	0.586	0.581	0.575	0.569	0.563
74	0.53	0.545	0.558	0.564	0.566	0.563	0.559	0.553	0.546	0.541
75	0.508	0.524	0.536	0.543	0.544	0.542	0.537	0.531	0.525	0.519
76	0.473	0.487	0.499	0.505	0.507	0.505	0.501	0.495	0.49	0.485
77	0.439	0.453	0.464	0.471	0.473	0.471	0.467	0.462	0.457	0.452
78	0.408	0.421	0.432	0.438	0.44	0.439	0.436	0.431	0.427	0.422
79	0.38	0.392	0.402	0.408	0.41	0.409	0.407	0.403	0.398	0.394
80	0.353	0.365	0.374	0.38	0.382	0.382	0.379	0.376	0.371	0.367
∞	0	0	0	0	0	0	0	0	0	0

Table A.17: Estimates of probabilities of survival, l_x, for females in absence of AIDS in Zimbabwe for the period 2000-2009. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	1	1	1	1	1	1	1	1	1	1
1	0.96	0.959	0.958	0.957	0.958	0.956	0.957	0.959	0.96	0.962
2	0.955	0.954	0.953	0.953	0.953	0.952	0.953	0.955	0.956	0.958
3	0.951	0.949	0.948	0.948	0.948	0.948	0.949	0.95	0.952	0.953
4	0.946	0.945	0.944	0.943	0.944	0.944	0.945	0.946	0.948	0.949
5	0.941	0.94	0.939	0.939	0.939	0.94	0.941	0.942	0.943	0.945
6	0.94	0.939	0.938	0.937	0.937	0.938	0.939	0.941	0.942	0.944
7	0.939	0.937	0.936	0.936	0.936	0.937	0.938	0.939	0.941	0.943
8	0.937	0.936	0.935	0.934	0.935	0.935	0.937	0.938	0.94	0.941
9	0.936	0.934	0.933	0.933	0.933	0.934	0.935	0.937	0.938	0.94
10	0.934	0.933	0.932	0.932	0.932	0.933	0.934	0.935	0.937	0.939
11	0.933	0.932	0.931	0.931	0.931	0.932	0.933	0.934	0.936	0.938
12	0.932	0.931	0.93	0.929	0.93	0.93	0.932	0.933	0.935	0.937
13	0.931	0.93	0.929	0.928	0.929	0.929	0.931	0.932	0.934	0.936
14	0.93	0.929	0.928	0.927	0.927	0.928	0.93	0.931	0.933	0.935
15	0.929	0.927	0.926	0.926	0.926	0.927	0.928	0.93	0.932	0.934
16	0.928	0.926	0.925	0.925	0.925	0.926	0.927	0.929	0.931	0.933
17	0.926	0.925	0.924	0.923	0.923	0.924	0.926	0.927	0.929	0.931
18	0.925	0.923	0.922	0.922	0.922	0.923	0.924	0.926	0.928	0.93
19	0.924	0.922	0.921	0.92	0.921	0.922	0.923	0.925	0.927	0.929
20	0.922	0.921	0.919	0.919	0.919	0.92	0.922	0.923	0.925	0.927
21	0.921	0.919	0.918	0.917	0.917	0.918	0.92	0.922	0.924	0.926
22	0.919	0.917	0.916	0.915	0.916	0.917	0.918	0.92	0.922	0.924
23	0.917	0.915	0.914	0.913	0.914	0.915	0.916	0.918	0.92	0.922
24	0.915	0.913	0.912	0.912	0.912	0.913	0.914	0.916	0.918	0.921
25	0.913	0.911	0.91	0.91	0.91	0.911	0.913	0.915	0.917	0.919
26	0.911	0.909	0.908	0.908	0.908	0.909	0.911	0.912	0.915	0.917
27	0.909	0.907	0.906	0.905	0.906	0.907	0.908	0.91	0.913	0.915
28	0.907	0.905	0.904	0.903	0.904	0.905	0.906	0.908	0.911	0.913
29	0.905	0.903	0.902	0.901	0.902	0.903	0.904	0.906	0.909	0.911
30	0.903	0.901	0.899	0.899	0.899	0.9	0.902	0.904	0.906	0.909
31	0.9	0.898	0.897	0.897	0.897	0.898	0.9	0.902	0.904	0.907
32	0.898	0.896	0.895	0.894	0.895	0.896	0.897	0.9	0.902	0.904
33	0.896	0.893	0.892	0.892	0.892	0.893	0.895	0.897	0.9	0.902

Continued on next page

AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
34	0.893	0.891	0.89	0.889	0.89	0.891	0.893	0.895	0.898	0.9
35	0.891	0.889	0.887	0.887	0.887	0.889	0.89	0.893	0.895	0.898
36	0.888	0.886	0.885	0.884	0.885	0.886	0.888	0.89	0.893	0.895
37	0.886	0.883	0.882	0.881	0.882	0.883	0.885	0.887	0.89	0.893
38	0.883	0.881	0.879	0.879	0.879	0.88	0.882	0.885	0.887	0.89
39	0.88	0.878	0.876	0.876	0.876	0.878	0.88	0.882	0.885	0.887
40	0.877	0.875	0.874	0.873	0.874	0.875	0.877	0.879	0.882	0.885
41	0.874	0.872	0.87	0.87	0.87	0.871	0.874	0.876	0.879	0.882
42	0.871	0.868	0.867	0.866	0.867	0.868	0.87	0.873	0.875	0.878
43	0.867	0.865	0.863	0.863	0.863	0.865	0.867	0.869	0.872	0.875
44	0.864	0.861	0.86	0.859	0.86	0.861	0.864	0.866	0.869	0.872
45	0.861	0.858	0.856	0.856	0.857	0.858	0.86	0.863	0.866	0.869
46	0.856	0.854	0.852	0.852	0.852	0.854	0.856	0.859	0.861	0.865
47	0.852	0.849	0.848	0.847	0.848	0.849	0.852	0.854	0.857	0.86
48	0.848	0.845	0.843	0.843	0.844	0.845	0.847	0.85	0.853	0.856
49	0.844	0.841	0.839	0.839	0.839	0.841	0.843	0.846	0.849	0.852
50	0.839	0.837	0.835	0.834	0.835	0.837	0.839	0.842	0.845	0.848
51	0.834	0.831	0.829	0.829	0.829	0.831	0.833	0.836	0.839	0.842
52	0.828	0.825	0.823	0.823	0.824	0.825	0.828	0.83	0.834	0.837
53	0.822	0.819	0.818	0.817	0.818	0.82	0.822	0.825	0.828	0.831
54	0.817	0.814	0.812	0.812	0.812	0.814	0.816	0.819	0.822	0.826
55	0.811	0.808	0.806	0.806	0.807	0.808	0.811	0.814	0.817	0.82
56	0.803	0.8	0.799	0.798	0.799	0.8	0.803	0.806	0.809	0.813
57	0.795	0.793	0.791	0.79	0.791	0.793	0.795	0.798	0.802	0.805
58	0.788	0.785	0.783	0.782	0.783	0.785	0.787	0.791	0.794	0.798
59	0.78	0.777	0.775	0.775	0.775	0.777	0.78	0.783	0.787	0.791
60	0.773	0.77	0.768	0.767	0.768	0.77	0.772	0.776	0.779	0.783
61	0.761	0.758	0.756	0.756	0.757	0.758	0.761	0.764	0.768	0.771
62	0.75	0.747	0.745	0.745	0.746	0.747	0.75	0.753	0.756	0.759
63	0.738	0.735	0.734	0.734	0.735	0.737	0.739	0.742	0.744	0.748
64	0.727	0.724	0.723	0.723	0.724	0.726	0.728	0.73	0.733	0.736
65	0.716	0.714	0.712	0.712	0.714	0.715	0.717	0.72	0.722	0.725
66	0.699	0.696	0.695	0.695	0.696	0.698	0.7	0.702	0.704	0.707
67	0.682	0.679	0.677	0.677	0.678	0.68	0.682	0.684	0.687	0.69
68	0.665	0.662	0.661	0.661	0.662	0.663	0.665	0.667	0.67	0.673
69	0.649	0.646	0.644	0.644	0.645	0.647	0.649	0.651	0.654	0.657

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AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
70	0.633	0.63	0.628	0.628	0.629	0.63	0.632	0.635	0.638	0.641
71	0.607	0.604	0.603	0.602	0.603	0.605	0.607	0.609	0.612	0.616
72	0.583	0.58	0.578	0.578	0.579	0.58	0.582	0.585	0.588	0.591
73	0.559	0.556	0.554	0.554	0.555	0.557	0.559	0.561	0.564	0.568
74	0.536	0.533	0.532	0.531	0.532	0.534	0.536	0.539	0.542	0.545
75	0.515	0.512	0.51	0.51	0.511	0.513	0.515	0.517	0.52	0.523
76	0.48	0.477	0.475	0.475	0.476	0.477	0.48	0.482	0.485	0.488
77	0.448	0.445	0.443	0.443	0.443	0.445	0.447	0.449	0.452	0.455
78	0.418	0.415	0.413	0.412	0.413	0.414	0.416	0.419	0.422	0.425
79	0.39	0.387	0.385	0.384	0.385	0.386	0.388	0.39	0.393	0.396
80	0.364	0.361	0.359	0.358	0.359	0.36	0.361	0.364	0.366	0.37
∞	0	0	0	0	0	0	0	0	0	0

Table A.18: Projections of probabilities of survival, l_x, for females in absence of AIDS in Zimbabwe for the period 2010-2019. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0	1	1	1	1	1	1	1	1	1	1
1	0.96	0.962	0.963	0.965	0.967	0.965	0.967	0.968	0.97	0.971
2	0.957	0.958	0.96	0.962	0.963	0.962	0.964	0.966	0.967	0.969
3	0.953	0.955	0.957	0.958	0.96	0.96	0.961	0.963	0.965	0.966
4	0.95	0.952	0.953	0.955	0.956	0.957	0.959	0.96	0.962	0.963
5	0.947	0.948	0.95	0.951	0.953	0.955	0.956	0.958	0.959	0.961
6	0.945	0.947	0.949	0.95	0.952	0.954	0.955	0.957	0.959	0.96
7	0.944	0.946	0.948	0.949	0.951	0.953	0.954	0.956	0.958	0.959
8	0.943	0.945	0.947	0.948	0.95	0.952	0.954	0.955	0.957	0.959
9	0.942	0.944	0.945	0.947	0.949	0.951	0.953	0.954	0.956	0.958
10	0.941	0.942	0.944	0.946	0.948	0.95	0.952	0.954	0.955	0.957
11	0.94	0.942	0.943	0.945	0.947	0.949	0.951	0.953	0.955	0.956
12	0.939	0.941	0.943	0.944	0.946	0.948	0.95	0.952	0.954	0.956
13	0.938	0.94	0.942	0.944	0.946	0.948	0.949	0.951	0.953	0.955
14	0.937	0.939	0.941	0.943	0.945	0.947	0.949	0.951	0.952	0.954
15	0.936	0.938	0.94	0.942	0.944	0.946	0.948	0.95	0.952	0.954
16	0.935	0.937	0.939	0.941	0.943	0.945	0.947	0.949	0.951	0.953
17	0.933	0.935	0.937	0.94	0.942	0.944	0.946	0.948	0.95	0.952
18	0.932	0.934	0.936	0.938	0.94	0.943	0.945	0.947	0.949	0.951
19	0.931	0.933	0.935	0.937	0.939	0.941	0.944	0.946	0.948	0.95
20	0.93	0.932	0.934	0.936	0.938	0.94	0.942	0.945	0.947	0.949
21	0.928	0.93	0.932	0.934	0.937	0.939	0.941	0.943	0.945	0.947
22	0.926	0.928	0.931	0.933	0.935	0.937	0.939	0.942	0.944	0.946
23	0.924	0.927	0.929	0.931	0.934	0.936	0.938	0.94	0.942	0.944
24	0.923	0.925	0.927	0.93	0.932	0.934	0.937	0.939	0.941	0.943
25	0.921	0.923	0.926	0.928	0.93	0.933	0.935	0.937	0.94	0.942
26	0.919	0.921	0.924	0.926	0.929	0.931	0.933	0.936	0.938	0.94
27	0.917	0.92	0.922	0.924	0.927	0.929	0.932	0.934	0.936	0.938
28	0.915	0.918	0.92	0.922	0.925	0.927	0.93	0.932	0.934	0.937
29	0.913	0.916	0.918	0.921	0.923	0.926	0.928	0.93	0.933	0.935
30	0.911	0.914	0.916	0.919	0.921	0.924	0.926	0.929	0.931	0.934
31	0.909	0.912	0.914	0.917	0.919	0.922	0.924	0.927	0.929	0.932
32	0.907	0.91	0.912	0.915	0.917	0.92	0.923	0.925	0.928	0.93
33	0.905	0.907	0.91	0.913	0.915	0.918	0.921	0.923	0.926	0.928

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AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
34	0.903	0.905	0.908	0.911	0.913	0.916	0.919	0.921	0.924	0.926
35	0.901	0.903	0.906	0.909	0.912	0.914	0.917	0.92	0.922	0.925
36	0.898	0.901	0.904	0.906	0.909	0.912	0.915	0.917	0.92	0.923
37	0.895	0.898	0.901	0.904	0.907	0.91	0.913	0.915	0.918	0.921
38	0.893	0.896	0.899	0.902	0.905	0.907	0.91	0.913	0.916	0.918
39	0.89	0.893	0.896	0.899	0.902	0.905	0.908	0.911	0.914	0.916
40	0.888	0.891	0.894	0.897	0.9	0.903	0.906	0.909	0.912	0.914
41	0.885	0.888	0.891	0.894	0.897	0.9	0.903	0.906	0.909	0.912
42	0.881	0.884	0.888	0.891	0.894	0.897	0.9	0.903	0.906	0.909
43	0.878	0.881	0.884	0.888	0.891	0.894	0.897	0.9	0.903	0.906
44	0.875	0.878	0.881	0.885	0.888	0.891	0.894	0.897	0.9	0.903
45	0.872	0.875	0.878	0.882	0.885	0.888	0.891	0.895	0.898	0.901
46	0.868	0.871	0.874	0.878	0.881	0.884	0.888	0.891	0.894	0.897
47	0.864	0.867	0.87	0.874	0.877	0.88	0.884	0.887	0.89	0.893
48	0.859	0.863	0.866	0.87	0.873	0.876	0.88	0.883	0.887	0.89
49	0.855	0.859	0.862	0.866	0.869	0.873	0.876	0.88	0.883	0.886
50	0.851	0.855	0.858	0.862	0.865	0.869	0.872	0.876	0.879	0.882
51	0.846	0.849	0.853	0.856	0.86	0.864	0.867	0.871	0.874	0.877
52	0.84	0.844	0.847	0.851	0.855	0.858	0.862	0.865	0.869	0.872
53	0.835	0.838	0.842	0.846	0.849	0.853	0.857	0.86	0.864	0.867
54	0.829	0.833	0.837	0.84	0.844	0.848	0.852	0.855	0.859	0.862
55	0.824	0.828	0.831	0.835	0.839	0.843	0.846	0.85	0.854	0.857
56	0.816	0.82	0.824	0.828	0.832	0.835	0.839	0.843	0.847	0.85
57	0.809	0.813	0.817	0.82	0.824	0.828	0.832	0.836	0.84	0.843
58	0.802	0.805	0.809	0.813	0.817	0.821	0.825	0.829	0.833	0.836
59	0.794	0.798	0.802	0.806	0.81	0.814	0.818	0.822	0.826	0.829
60	0.787	0.791	0.795	0.799	0.803	0.807	0.811	0.815	0.819	0.822
61	0.775	0.779	0.783	0.788	0.792	0.796	0.8	0.804	0.808	0.812
62	0.763	0.768	0.772	0.777	0.782	0.786	0.79	0.794	0.798	0.801
63	0.752	0.756	0.761	0.766	0.771	0.776	0.78	0.784	0.787	0.791
64	0.74	0.745	0.75	0.756	0.761	0.766	0.77	0.773	0.777	0.78
65	0.729	0.734	0.74	0.745	0.751	0.756	0.76	0.763	0.767	0.77
66	0.711	0.717	0.723	0.728	0.734	0.739	0.743	0.747	0.75	0.754
67	0.694	0.7	0.706	0.712	0.717	0.722	0.726	0.73	0.734	0.737
68	0.678	0.683	0.69	0.695	0.701	0.706	0.71	0.714	0.718	0.721
69	0.662	0.667	0.674	0.68	0.685	0.69	0.695	0.699	0.702	0.706

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AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
70	0.646	0.652	0.658	0.664	0.67	0.675	0.679	0.683	0.687	0.691
71	0.62	0.626	0.632	0.638	0.644	0.649	0.654	0.658	0.662	0.665
72	0.596	0.601	0.607	0.613	0.619	0.625	0.629	0.633	0.637	0.641
73	0.572	0.577	0.583	0.589	0.595	0.601	0.606	0.61	0.614	0.617
74	0.549	0.555	0.56	0.566	0.572	0.578	0.583	0.587	0.591	0.594
75	0.528	0.533	0.538	0.544	0.55	0.556	0.561	0.565	0.569	0.572
76	0.492	0.497	0.503	0.509	0.515	0.52	0.525	0.529	0.533	0.537
77	0.46	0.465	0.47	0.476	0.481	0.486	0.491	0.495	0.499	0.503
78	0.429	0.434	0.439	0.445	0.45	0.455	0.459	0.463	0.467	0.472
79	0.4	0.405	0.411	0.416	0.421	0.425	0.429	0.433	0.438	0.442
80	0.374	0.379	0.384	0.389	0.393	0.397	0.401	0.406	0.41	0.415
∞	0	0	0	0	0	0	0	0	0	0

Table A.19: Projections of probabilities of survival, l_x, for females in absence of AIDS in Zimbabwe for the period 2020-2029. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
0	1	1	1	1	1	1	1	1	1	1
1	0.97	0.971	0.972	0.974	0.975	0.974	0.975	0.976	0.977	0.977
2	0.968	0.969	0.97	0.972	0.973	0.972	0.973	0.974	0.975	0.976
3	0.966	0.967	0.969	0.97	0.971	0.971	0.972	0.973	0.974	0.974
4	0.964	0.965	0.967	0.968	0.969	0.97	0.97	0.971	0.972	0.973
5	0.962	0.964	0.965	0.966	0.967	0.968	0.969	0.97	0.971	0.971
6	0.962	0.963	0.964	0.965	0.967	0.967	0.968	0.969	0.97	0.971
7	0.961	0.962	0.964	0.965	0.966	0.967	0.968	0.969	0.97	0.97
8	0.96	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.97
9	0.959	0.961	0.962	0.964	0.965	0.966	0.967	0.968	0.969	0.969
10	0.959	0.96	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969
11	0.958	0.96	0.961	0.962	0.964	0.965	0.966	0.967	0.968	0.969
12	0.957	0.959	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968
13	0.957	0.958	0.96	0.961	0.963	0.964	0.965	0.966	0.967	0.968
14	0.956	0.958	0.959	0.961	0.962	0.963	0.964	0.965	0.966	0.967
15	0.955	0.957	0.959	0.96	0.961	0.963	0.964	0.965	0.966	0.967
16	0.954	0.956	0.958	0.959	0.961	0.962	0.963	0.964	0.965	0.966
17	0.954	0.955	0.957	0.958	0.96	0.961	0.962	0.963	0.964	0.965
18	0.953	0.954	0.956	0.957	0.959	0.96	0.961	0.962	0.963	0.964
19	0.952	0.953	0.955	0.957	0.958	0.959	0.96	0.962	0.963	0.964
20	0.951	0.952	0.954	0.956	0.957	0.958	0.96	0.961	0.962	0.963
21	0.949	0.951	0.953	0.954	0.956	0.957	0.958	0.96	0.961	0.962
22	0.948	0.95	0.952	0.953	0.955	0.956	0.957	0.959	0.96	0.961
23	0.946	0.948	0.95	0.952	0.953	0.955	0.956	0.957	0.959	0.96
24	0.945	0.947	0.949	0.951	0.952	0.954	0.955	0.956	0.958	0.959
25	0.944	0.946	0.948	0.949	0.951	0.952	0.954	0.955	0.956	0.958
26	0.942	0.944	0.946	0.948	0.949	0.951	0.952	0.954	0.955	0.956
27	0.941	0.943	0.944	0.946	0.948	0.95	0.951	0.952	0.954	0.955
28	0.939	0.941	0.943	0.945	0.946	0.948	0.95	0.951	0.952	0.954
29	0.937	0.939	0.941	0.943	0.945	0.947	0.948	0.95	0.951	0.953
30	0.936	0.938	0.94	0.942	0.944	0.945	0.947	0.948	0.95	0.951
31	0.934	0.936	0.938	0.94	0.942	0.944	0.945	0.947	0.948	0.95
32	0.932	0.935	0.937	0.939	0.94	0.942	0.944	0.945	0.947	0.949
33	0.931	0.933	0.935	0.937	0.939	0.941	0.942	0.944	0.946	0.947

Continued on next page

AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
34	0.929	0.931	0.933	0.935	0.937	0.939	0.941	0.943	0.944	0.946
35	0.927	0.929	0.932	0.934	0.936	0.938	0.939	0.941	0.943	0.944
36	0.925	0.927	0.93	0.932	0.934	0.936	0.938	0.939	0.941	0.943
37	0.923	0.925	0.928	0.93	0.932	0.934	0.936	0.938	0.939	0.941
38	0.921	0.924	0.926	0.928	0.93	0.932	0.934	0.936	0.938	0.939
39	0.919	0.922	0.924	0.926	0.928	0.93	0.932	0.934	0.936	0.938
40	0.917	0.92	0.922	0.924	0.926	0.928	0.93	0.932	0.934	0.936
41	0.914	0.917	0.919	0.922	0.924	0.926	0.928	0.93	0.932	0.934
42	0.912	0.914	0.917	0.919	0.921	0.924	0.926	0.928	0.93	0.931
43	0.909	0.912	0.914	0.917	0.919	0.921	0.923	0.925	0.927	0.929
44	0.906	0.909	0.912	0.914	0.916	0.919	0.921	0.923	0.925	0.927
45	0.904	0.906	0.909	0.912	0.914	0.916	0.918	0.921	0.923	0.925
46	0.9	0.903	0.905	0.908	0.911	0.913	0.915	0.917	0.919	0.921
47	0.896	0.899	0.902	0.905	0.907	0.909	0.912	0.914	0.916	0.918
48	0.893	0.896	0.898	0.901	0.904	0.906	0.908	0.911	0.913	0.915
49	0.889	0.892	0.895	0.898	0.9	0.903	0.905	0.907	0.91	0.912
50	0.886	0.889	0.891	0.894	0.897	0.899	0.902	0.904	0.906	0.909
51	0.88	0.884	0.887	0.889	0.892	0.895	0.897	0.9	0.902	0.904
52	0.875	0.879	0.882	0.884	0.887	0.89	0.892	0.895	0.897	0.9
53	0.87	0.874	0.877	0.88	0.882	0.885	0.888	0.89	0.893	0.895
54	0.865	0.869	0.872	0.875	0.878	0.88	0.883	0.886	0.888	0.891
55	0.861	0.864	0.867	0.87	0.873	0.876	0.878	0.881	0.884	0.886
56	0.854	0.857	0.86	0.863	0.866	0.869	0.872	0.875	0.877	0.88
57	0.847	0.85	0.853	0.856	0.859	0.862	0.865	0.868	0.871	0.873
58	0.84	0.843	0.846	0.85	0.853	0.856	0.859	0.861	0.864	0.867
59	0.833	0.836	0.84	0.843	0.846	0.849	0.852	0.855	0.858	0.861
60	0.826	0.829	0.833	0.836	0.839	0.842	0.846	0.849	0.851	0.854
61	0.815	0.819	0.822	0.826	0.829	0.832	0.835	0.838	0.841	0.844
62	0.805	0.808	0.812	0.815	0.819	0.822	0.825	0.829	0.832	0.834
63	0.794	0.798	0.802	0.805	0.809	0.812	0.816	0.819	0.822	0.825
64	0.784	0.788	0.792	0.795	0.799	0.802	0.806	0.809	0.812	0.815
65	0.774	0.778	0.782	0.785	0.789	0.793	0.796	0.799	0.802	0.806
66	0.757	0.761	0.765	0.769	0.773	0.776	0.78	0.783	0.786	0.789
67	0.741	0.745	0.748	0.752	0.756	0.76	0.764	0.767	0.771	0.774
68	0.725	0.728	0.732	0.736	0.74	0.744	0.748	0.752	0.755	0.758
69	0.709	0.713	0.717	0.72	0.725	0.729	0.732	0.736	0.74	0.743

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AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
70	0.694	0.697	0.701	0.705	0.709	0.713	0.717	0.721	0.725	0.728
71	0.669	0.672	0.676	0.68	0.684	0.688	0.692	0.696	0.7	0.704
72	0.644	0.648	0.652	0.656	0.66	0.664	0.668	0.672	0.676	0.68
73	0.621	0.624	0.629	0.633	0.637	0.641	0.645	0.649	0.653	0.656
74	0.598	0.602	0.606	0.611	0.615	0.619	0.623	0.627	0.63	0.634
75	0.576	0.58	0.585	0.589	0.593	0.597	0.601	0.605	0.609	0.612
76	0.541	0.545	0.55	0.555	0.559	0.563	0.567	0.57	0.574	0.577
77	0.508	0.513	0.518	0.522	0.527	0.531	0.534	0.538	0.541	0.544
78	0.477	0.482	0.487	0.492	0.496	0.5	0.504	0.507	0.51	0.513
79	0.447	0.453	0.458	0.463	0.468	0.472	0.475	0.478	0.481	0.483
80	0.42	0.426	0.431	0.436	0.441	0.445	0.448	0.451	0.453	0.455
∞	0	0	0	0	0	0	0	0	0	0

Table A.20: Projections of probabilities of survival, l_x, for females in absence of AIDS in Zimbabwe for the period 2030-2039. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
0	1	1	1	1	1	1	1	1	1	1
1	0.977	0.978	0.978	0.979	0.98	0.979	0.98	0.981	0.981	0.982
2	0.976	0.976	0.977	0.978	0.979	0.978	0.979	0.98	0.98	0.981
3	0.974	0.975	0.976	0.977	0.977	0.978	0.978	0.979	0.979	0.98
4	0.973	0.974	0.975	0.976	0.976	0.977	0.977	0.978	0.978	0.979
5	0.972	0.973	0.974	0.974	0.975	0.976	0.976	0.977	0.977	0.978
6	0.972	0.972	0.973	0.974	0.975	0.975	0.976	0.976	0.977	0.977
7	0.971	0.972	0.973	0.974	0.974	0.975	0.976	0.976	0.977	0.977
8	0.971	0.972	0.972	0.973	0.974	0.975	0.975	0.976	0.976	0.977
9	0.97	0.971	0.972	0.973	0.973	0.974	0.975	0.975	0.976	0.976
10	0.97	0.971	0.972	0.972	0.973	0.974	0.974	0.975	0.976	0.976
11	0.969	0.97	0.971	0.972	0.973	0.973	0.974	0.975	0.975	0.976
12	0.969	0.97	0.971	0.972	0.972	0.973	0.974	0.974	0.975	0.976
13	0.969	0.969	0.97	0.971	0.972	0.973	0.973	0.974	0.975	0.975
14	0.968	0.969	0.97	0.971	0.972	0.972	0.973	0.974	0.974	0.975
15	0.968	0.969	0.969	0.97	0.971	0.972	0.973	0.973	0.974	0.975
16	0.967	0.968	0.969	0.97	0.971	0.971	0.972	0.973	0.973	0.974
17	0.966	0.967	0.968	0.969	0.97	0.971	0.971	0.972	0.973	0.973
18	0.965	0.966	0.967	0.968	0.969	0.97	0.971	0.972	0.972	0.973
19	0.965	0.966	0.967	0.968	0.969	0.969	0.97	0.971	0.972	0.972
20	0.964	0.965	0.966	0.967	0.968	0.969	0.97	0.97	0.971	0.972
21	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.97	0.97	0.971
22	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.97	0.97
23	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.969
24	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969
25	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968
26	0.958	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967
27	0.956	0.958	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966
28	0.955	0.956	0.958	0.959	0.96	0.961	0.962	0.963	0.964	0.965
29	0.954	0.955	0.957	0.958	0.959	0.96	0.961	0.962	0.963	0.964
30	0.953	0.954	0.955	0.957	0.958	0.959	0.96	0.961	0.962	0.963
31	0.951	0.953	0.954	0.955	0.957	0.958	0.959	0.96	0.961	0.962
32	0.95	0.951	0.953	0.954	0.956	0.957	0.958	0.959	0.96	0.961
33	0.949	0.95	0.952	0.953	0.954	0.956	0.957	0.958	0.959	0.96

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AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
34	0.947	0.949	0.95	0.952	0.953	0.954	0.956	0.957	0.958	0.959
35	0.946	0.948	0.949	0.95	0.952	0.953	0.954	0.956	0.957	0.958
36	0.944	0.946	0.947	0.949	0.95	0.952	0.953	0.954	0.955	0.956
37	0.943	0.944	0.946	0.947	0.949	0.95	0.952	0.953	0.954	0.955
38	0.941	0.943	0.944	0.946	0.947	0.949	0.95	0.951	0.953	0.954
39	0.939	0.941	0.943	0.944	0.946	0.947	0.949	0.95	0.951	0.952
40	0.938	0.94	0.941	0.943	0.944	0.946	0.947	0.949	0.95	0.951
41	0.936	0.937	0.939	0.941	0.942	0.944	0.945	0.947	0.948	0.949
42	0.933	0.935	0.937	0.939	0.94	0.942	0.943	0.945	0.946	0.947
43	0.931	0.933	0.935	0.936	0.938	0.94	0.941	0.943	0.944	0.945
44	0.929	0.931	0.933	0.934	0.936	0.938	0.939	0.941	0.942	0.943
45	0.927	0.929	0.93	0.932	0.934	0.936	0.937	0.939	0.94	0.941
46	0.923	0.925	0.927	0.929	0.931	0.933	0.934	0.936	0.937	0.938
47	0.92	0.922	0.924	0.926	0.928	0.93	0.931	0.933	0.934	0.936
48	0.917	0.919	0.921	0.923	0.925	0.927	0.929	0.93	0.932	0.933
49	0.914	0.916	0.918	0.92	0.922	0.924	0.926	0.927	0.929	0.93
50	0.911	0.913	0.915	0.917	0.919	0.921	0.923	0.924	0.926	0.927
51	0.906	0.909	0.911	0.913	0.915	0.917	0.919	0.92	0.922	0.923
52	0.902	0.904	0.906	0.908	0.911	0.913	0.914	0.916	0.918	0.919
53	0.897	0.9	0.902	0.904	0.906	0.908	0.91	0.912	0.914	0.915
54	0.893	0.895	0.898	0.9	0.902	0.904	0.906	0.908	0.91	0.911
55	0.889	0.891	0.893	0.896	0.898	0.9	0.902	0.904	0.906	0.907
56	0.882	0.885	0.887	0.889	0.892	0.894	0.896	0.898	0.9	0.901
57	0.876	0.878	0.881	0.883	0.886	0.888	0.89	0.892	0.894	0.896
58	0.87	0.872	0.875	0.877	0.879	0.882	0.884	0.886	0.888	0.89
59	0.863	0.866	0.868	0.871	0.873	0.876	0.878	0.88	0.882	0.884
60	0.857	0.86	0.862	0.865	0.868	0.87	0.872	0.874	0.876	0.878
61	0.847	0.85	0.853	0.855	0.858	0.86	0.863	0.865	0.867	0.869
62	0.837	0.84	0.843	0.846	0.848	0.851	0.853	0.856	0.858	0.86
63	0.828	0.831	0.833	0.836	0.839	0.842	0.844	0.847	0.849	0.851
64	0.818	0.821	0.824	0.827	0.83	0.832	0.835	0.838	0.84	0.842
65	0.809	0.812	0.815	0.818	0.82	0.823	0.826	0.829	0.831	0.834
66	0.793	0.796	0.799	0.802	0.805	0.808	0.811	0.814	0.816	0.819
67	0.777	0.78	0.783	0.786	0.79	0.793	0.796	0.799	0.801	0.804
68	0.762	0.765	0.768	0.771	0.775	0.778	0.781	0.784	0.787	0.79
69	0.747	0.75	0.753	0.757	0.76	0.763	0.766	0.77	0.773	0.775

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AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
70	0.732	0.735	0.739	0.742	0.746	0.749	0.752	0.756	0.759	0.761
71	0.707	0.711	0.714	0.718	0.721	0.725	0.728	0.732	0.735	0.738
72	0.683	0.687	0.691	0.694	0.698	0.701	0.705	0.708	0.712	0.715
73	0.66	0.664	0.668	0.671	0.675	0.679	0.682	0.686	0.689	0.692
74	0.638	0.642	0.646	0.649	0.653	0.657	0.66	0.664	0.667	0.671
75	0.616	0.62	0.624	0.628	0.632	0.636	0.639	0.643	0.646	0.65
76	0.581	0.584	0.588	0.592	0.596	0.599	0.603	0.607	0.611	0.615
77	0.547	0.551	0.554	0.558	0.561	0.565	0.569	0.574	0.578	0.582
78	0.516	0.519	0.522	0.525	0.529	0.533	0.537	0.542	0.546	0.551
79	0.486	0.489	0.492	0.495	0.499	0.503	0.507	0.512	0.516	0.521
80	0.458	0.46	0.463	0.466	0.47	0.474	0.479	0.483	0.488	0.493
∞	0	0	0	0	0	0	0	0	0	0

Table A.21: Projections of probabilities of survival, l_x, for females in absence of AIDS in Zimbabwe for the period 2040-2050. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
0	1	1	1	1	1	1	1	1	1	1	1
1	0.981	0.982	0.982	0.983	0.983	0.983	0.983	0.984	0.984	0.984	0.985
2	0.981	0.981	0.981	0.982	0.982	0.982	0.983	0.983	0.983	0.984	0.984
3	0.98	0.98	0.981	0.981	0.981	0.981	0.982	0.982	0.983	0.983	0.983
4	0.979	0.979	0.98	0.98	0.98	0.981	0.981	0.981	0.982	0.982	0.983
5	0.978	0.979	0.979	0.979	0.98	0.98	0.98	0.981	0.981	0.981	0.982
6	0.978	0.978	0.979	0.979	0.979	0.98	0.98	0.98	0.981	0.981	0.982
7	0.978	0.978	0.978	0.979	0.979	0.979	0.98	0.98	0.981	0.981	0.981
8	0.977	0.978	0.978	0.978	0.979	0.979	0.98	0.98	0.98	0.981	0.981
9	0.977	0.977	0.978	0.978	0.979	0.979	0.979	0.98	0.98	0.98	0.981
10	0.977	0.977	0.977	0.978	0.978	0.979	0.979	0.979	0.98	0.98	0.981
11	0.976	0.977	0.977	0.978	0.978	0.978	0.979	0.979	0.98	0.98	0.98
12	0.976	0.976	0.977	0.977	0.978	0.978	0.978	0.979	0.979	0.98	0.98
13	0.976	0.976	0.977	0.977	0.977	0.978	0.978	0.979	0.979	0.979	0.98
14	0.975	0.976	0.976	0.977	0.977	0.977	0.978	0.978	0.979	0.979	0.98
15	0.975	0.975	0.976	0.976	0.977	0.977	0.978	0.978	0.978	0.979	0.979
16	0.974	0.975	0.975	0.976	0.976	0.977	0.977	0.978	0.978	0.978	0.979
17	0.974	0.974	0.975	0.975	0.976	0.976	0.977	0.977	0.978	0.978	0.979
18	0.973	0.974	0.974	0.975	0.975	0.976	0.976	0.977	0.977	0.978	0.978
19	0.973	0.973	0.974	0.974	0.975	0.975	0.976	0.976	0.977	0.977	0.978
20	0.972	0.973	0.973	0.974	0.974	0.975	0.975	0.976	0.976	0.977	0.977
21	0.972	0.972	0.973	0.973	0.974	0.974	0.975	0.975	0.976	0.976	0.977
22	0.971	0.971	0.972	0.972	0.973	0.973	0.974	0.974	0.975	0.975	0.976
23	0.97	0.971	0.971	0.972	0.972	0.973	0.973	0.974	0.974	0.975	0.975
24	0.969	0.97	0.97	0.971	0.971	0.972	0.973	0.973	0.974	0.974	0.975
25	0.968	0.969	0.97	0.97	0.971	0.971	0.972	0.972	0.973	0.974	0.974
26	0.967	0.968	0.969	0.969	0.97	0.97	0.971	0.972	0.972	0.973	0.973
27	0.967	0.967	0.968	0.968	0.969	0.97	0.97	0.971	0.971	0.972	0.973
28	0.966	0.966	0.967	0.967	0.968	0.969	0.969	0.97	0.971	0.971	0.972
29	0.965	0.965	0.966	0.967	0.967	0.968	0.968	0.969	0.97	0.97	0.971
30	0.964	0.964	0.965	0.966	0.966	0.967	0.968	0.968	0.969	0.97	0.97
31	0.963	0.963	0.964	0.965	0.965	0.966	0.967	0.967	0.968	0.969	0.969
32	0.962	0.962	0.963	0.964	0.964	0.965	0.966	0.966	0.967	0.968	0.968
33	0.961	0.961	0.962	0.963	0.963	0.964	0.965	0.965	0.966	0.967	0.968

Continued on next page

AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
34	0.959	0.96	0.961	0.962	0.962	0.963	0.964	0.965	0.965	0.966	0.967
35	0.958	0.959	0.96	0.961	0.961	0.962	0.963	0.964	0.964	0.965	0.966
36	0.957	0.958	0.959	0.959	0.96	0.961	0.962	0.962	0.963	0.964	0.965
37	0.956	0.957	0.957	0.958	0.959	0.96	0.96	0.961	0.962	0.963	0.963
38	0.954	0.955	0.956	0.957	0.958	0.958	0.959	0.96	0.961	0.962	0.962
39	0.953	0.954	0.955	0.956	0.956	0.957	0.958	0.959	0.96	0.96	0.961
40	0.952	0.953	0.953	0.954	0.955	0.956	0.957	0.958	0.958	0.959	0.96
41	0.95	0.951	0.952	0.953	0.953	0.954	0.955	0.956	0.957	0.958	0.958
42	0.948	0.949	0.95	0.951	0.952	0.952	0.953	0.954	0.955	0.956	0.957
43	0.946	0.947	0.948	0.949	0.95	0.951	0.952	0.953	0.953	0.954	0.955
44	0.944	0.945	0.946	0.947	0.948	0.949	0.95	0.951	0.952	0.953	0.954
45	0.942	0.943	0.944	0.945	0.946	0.947	0.948	0.949	0.95	0.951	0.952
46	0.94	0.941	0.942	0.943	0.944	0.945	0.946	0.947	0.948	0.949	0.95
47	0.937	0.938	0.939	0.94	0.941	0.942	0.943	0.944	0.945	0.946	0.947
48	0.934	0.935	0.936	0.937	0.938	0.939	0.941	0.942	0.943	0.944	0.945
49	0.931	0.932	0.934	0.935	0.936	0.937	0.938	0.939	0.94	0.941	0.942
50	0.929	0.93	0.931	0.932	0.933	0.934	0.936	0.937	0.938	0.939	0.94
51	0.925	0.926	0.927	0.928	0.929	0.931	0.932	0.933	0.934	0.935	0.936
52	0.921	0.922	0.923	0.924	0.926	0.927	0.928	0.929	0.93	0.932	0.933
53	0.917	0.918	0.919	0.921	0.922	0.923	0.924	0.926	0.927	0.928	0.929
54	0.913	0.914	0.915	0.917	0.918	0.919	0.921	0.922	0.923	0.924	0.926
55	0.909	0.91	0.911	0.913	0.914	0.916	0.917	0.918	0.92	0.921	0.922
56	0.903	0.904	0.906	0.907	0.909	0.91	0.911	0.913	0.914	0.915	0.917
57	0.897	0.899	0.9	0.902	0.903	0.905	0.906	0.907	0.909	0.91	0.912
58	0.891	0.893	0.895	0.896	0.898	0.899	0.901	0.902	0.904	0.905	0.906
59	0.886	0.887	0.889	0.891	0.892	0.894	0.895	0.897	0.898	0.9	0.901
60	0.88	0.882	0.883	0.885	0.887	0.888	0.89	0.891	0.893	0.894	0.896
61	0.871	0.873	0.875	0.876	0.878	0.88	0.881	0.883	0.885	0.886	0.888
62	0.862	0.864	0.866	0.868	0.87	0.871	0.873	0.875	0.876	0.878	0.879
63	0.853	0.855	0.857	0.859	0.861	0.863	0.865	0.866	0.868	0.869	0.871
64	0.845	0.847	0.849	0.851	0.853	0.855	0.856	0.858	0.86	0.861	0.863
65	0.836	0.838	0.84	0.842	0.844	0.846	0.848	0.85	0.851	0.853	0.854
66	0.821	0.823	0.826	0.828	0.83	0.832	0.834	0.836	0.837	0.839	0.841
67	0.806	0.809	0.811	0.814	0.816	0.818	0.82	0.822	0.824	0.825	0.827
68	0.792	0.795	0.797	0.8	0.802	0.804	0.806	0.808	0.81	0.812	0.814
69	0.778	0.781	0.783	0.786	0.788	0.791	0.793	0.795	0.797	0.799	0.8

Continued on next page

AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
70	0.764	0.767	0.77	0.772	0.775	0.777	0.78	0.782	0.784	0.786	0.787
71	0.741	0.744	0.746	0.749	0.752	0.755	0.757	0.759	0.761	0.764	0.766
72	0.718	0.721	0.724	0.727	0.73	0.733	0.735	0.738	0.74	0.742	0.744
73	0.696	0.699	0.702	0.705	0.708	0.711	0.714	0.716	0.719	0.721	0.724
74	0.674	0.678	0.681	0.684	0.687	0.69	0.693	0.696	0.699	0.701	0.703
75	0.654	0.657	0.661	0.664	0.667	0.67	0.673	0.676	0.679	0.681	0.684
76	0.619	0.623	0.627	0.63	0.633	0.636	0.64	0.642	0.645	0.648	0.651
77	0.586	0.59	0.594	0.598	0.601	0.604	0.608	0.611	0.614	0.616	0.619
78	0.555	0.559	0.563	0.567	0.571	0.574	0.577	0.58	0.583	0.586	0.589
79	0.526	0.53	0.534	0.538	0.542	0.545	0.548	0.552	0.555	0.558	0.56
80	0.498	0.502	0.507	0.511	0.514	0.518	0.521	0.524	0.527	0.53	0.533
∞	0	0	0	0	0	0	0	0	0	0	0

Table A.22: Estimates of probabilities of survival, l_x, for males in presence of AIDS in Zimbabwe for the period 1980-1989. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	1	1	1	1	1	1	1	1	1	1
1	0.91	0.916	0.922	0.927	0.932	0.936	0.939	0.942	0.944	0.946
2	0.9	0.906	0.912	0.917	0.921	0.925	0.929	0.932	0.934	0.936
3	0.89	0.896	0.902	0.907	0.911	0.915	0.918	0.921	0.924	0.925
4	0.88	0.886	0.892	0.897	0.901	0.905	0.908	0.911	0.913	0.915
5	0.871	0.876	0.882	0.887	0.891	0.895	0.898	0.901	0.903	0.905
6	0.868	0.874	0.879	0.884	0.889	0.892	0.896	0.899	0.901	0.903
7	0.866	0.871	0.877	0.882	0.886	0.89	0.894	0.897	0.899	0.901
8	0.863	0.869	0.874	0.879	0.884	0.888	0.891	0.894	0.897	0.9
9	0.861	0.867	0.872	0.877	0.881	0.885	0.889	0.892	0.895	0.898
10	0.858	0.864	0.87	0.874	0.879	0.883	0.887	0.89	0.893	0.896
11	0.856	0.862	0.867	0.873	0.877	0.881	0.885	0.888	0.892	0.894
12	0.854	0.86	0.865	0.871	0.875	0.879	0.883	0.887	0.89	0.893
13	0.852	0.858	0.863	0.869	0.873	0.877	0.881	0.885	0.888	0.891
14	0.85	0.856	0.861	0.867	0.871	0.876	0.879	0.883	0.887	0.89
15	0.848	0.854	0.86	0.865	0.869	0.874	0.878	0.881	0.885	0.888
16	0.845	0.851	0.857	0.862	0.867	0.871	0.875	0.879	0.883	0.886
17	0.842	0.848	0.854	0.859	0.864	0.869	0.873	0.877	0.88	0.884
18	0.839	0.846	0.851	0.857	0.862	0.866	0.87	0.874	0.878	0.881
19	0.836	0.843	0.849	0.854	0.859	0.864	0.868	0.872	0.875	0.879
20	0.834	0.84	0.846	0.851	0.856	0.861	0.865	0.869	0.873	0.877
21	0.83	0.837	0.843	0.848	0.853	0.858	0.862	0.866	0.87	0.873
22	0.827	0.834	0.839	0.845	0.85	0.854	0.858	0.862	0.866	0.869
23	0.824	0.83	0.836	0.841	0.846	0.851	0.855	0.859	0.862	0.866
24	0.821	0.827	0.833	0.838	0.843	0.847	0.851	0.855	0.859	0.862
25	0.818	0.824	0.83	0.835	0.84	0.844	0.848	0.852	0.855	0.859
26	0.814	0.82	0.825	0.831	0.836	0.84	0.844	0.848	0.852	0.855
27	0.809	0.816	0.821	0.827	0.832	0.836	0.84	0.844	0.848	0.851
28	0.805	0.811	0.817	0.823	0.828	0.832	0.836	0.84	0.844	0.847
29	0.801	0.807	0.813	0.819	0.824	0.828	0.833	0.837	0.841	0.844
30	0.797	0.803	0.809	0.815	0.82	0.824	0.829	0.833	0.837	0.84
31	0.793	0.799	0.805	0.811	0.816	0.82	0.825	0.829	0.833	0.836
32	0.789	0.796	0.802	0.807	0.812	0.817	0.821	0.825	0.829	0.832
33	0.786	0.792	0.798	0.803	0.808	0.813	0.817	0.821	0.825	0.828

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AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
34	0.782	0.788	0.794	0.799	0.804	0.809	0.813	0.817	0.821	0.824
35	0.779	0.785	0.79	0.796	0.8	0.805	0.809	0.813	0.817	0.819
36	0.776	0.781	0.787	0.791	0.796	0.8	0.804	0.809	0.813	0.815
37	0.773	0.778	0.783	0.787	0.791	0.795	0.8	0.804	0.808	0.811
38	0.77	0.775	0.779	0.783	0.787	0.791	0.795	0.799	0.804	0.807
39	0.768	0.772	0.775	0.779	0.782	0.786	0.79	0.795	0.799	0.802
40	0.765	0.768	0.771	0.774	0.777	0.781	0.785	0.79	0.795	0.798
41	0.759	0.763	0.766	0.769	0.772	0.776	0.78	0.785	0.79	0.793
42	0.753	0.757	0.761	0.764	0.767	0.771	0.775	0.78	0.785	0.788
43	0.747	0.751	0.755	0.759	0.762	0.766	0.77	0.775	0.78	0.784
44	0.741	0.746	0.75	0.754	0.757	0.761	0.765	0.77	0.776	0.779
45	0.736	0.74	0.745	0.748	0.752	0.756	0.76	0.765	0.771	0.774
46	0.73	0.734	0.738	0.742	0.746	0.749	0.754	0.759	0.764	0.768
47	0.724	0.728	0.732	0.736	0.739	0.743	0.747	0.752	0.758	0.761
48	0.718	0.722	0.726	0.729	0.733	0.736	0.741	0.746	0.751	0.755
49	0.712	0.716	0.72	0.723	0.726	0.73	0.734	0.739	0.745	0.749
50	0.706	0.71	0.714	0.717	0.72	0.723	0.728	0.733	0.739	0.743
51	0.699	0.703	0.706	0.709	0.712	0.716	0.72	0.725	0.731	0.735
52	0.693	0.696	0.699	0.702	0.704	0.708	0.712	0.717	0.723	0.727
53	0.686	0.689	0.692	0.694	0.697	0.7	0.704	0.709	0.716	0.72
54	0.68	0.682	0.685	0.687	0.689	0.692	0.696	0.702	0.708	0.713
55	0.673	0.676	0.678	0.68	0.682	0.685	0.689	0.694	0.7	0.705
56	0.663	0.666	0.668	0.67	0.672	0.674	0.678	0.683	0.69	0.695
57	0.653	0.656	0.658	0.659	0.661	0.664	0.668	0.673	0.68	0.685
58	0.644	0.646	0.648	0.649	0.651	0.654	0.657	0.663	0.67	0.675
59	0.634	0.636	0.638	0.639	0.641	0.643	0.647	0.653	0.66	0.666
60	0.625	0.627	0.628	0.63	0.631	0.634	0.637	0.643	0.65	0.656
61	0.612	0.614	0.615	0.615	0.617	0.619	0.623	0.628	0.636	0.643
62	0.6	0.601	0.601	0.602	0.603	0.605	0.609	0.614	0.622	0.629
63	0.588	0.588	0.588	0.588	0.589	0.591	0.595	0.601	0.609	0.616
64	0.576	0.575	0.575	0.575	0.575	0.577	0.581	0.587	0.596	0.603
65	0.564	0.563	0.563	0.562	0.562	0.564	0.568	0.574	0.583	0.591
66	0.544	0.544	0.544	0.544	0.544	0.546	0.55	0.556	0.564	0.572
67	0.525	0.526	0.527	0.527	0.527	0.529	0.533	0.538	0.546	0.554
68	0.507	0.509	0.51	0.51	0.511	0.513	0.516	0.521	0.529	0.536
69	0.489	0.492	0.493	0.494	0.495	0.497	0.5	0.505	0.512	0.519

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AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
70	0.472	0.475	0.477	0.478	0.479	0.481	0.484	0.489	0.496	0.502
71	0.45	0.452	0.453	0.453	0.454	0.456	0.459	0.464	0.472	0.479
72	0.429	0.429	0.43	0.43	0.43	0.432	0.435	0.441	0.449	0.456
73	0.408	0.408	0.408	0.407	0.407	0.409	0.413	0.419	0.427	0.435
74	0.389	0.388	0.387	0.386	0.386	0.388	0.392	0.398	0.406	0.414
75	0.37	0.369	0.367	0.366	0.365	0.367	0.371	0.378	0.387	0.395
76	0.333	0.333	0.332	0.331	0.332	0.334	0.338	0.345	0.353	0.361
77	0.3	0.3	0.3	0.3	0.301	0.304	0.309	0.315	0.323	0.33
78	0.27	0.271	0.271	0.272	0.274	0.277	0.281	0.287	0.295	0.302
79	0.243	0.244	0.245	0.246	0.248	0.252	0.256	0.262	0.27	0.276
80	0.218	0.22	0.222	0.223	0.226	0.229	0.234	0.24	0.246	0.252
∞	0	0	0	0	0	0	0	0	0	0

Table A.23: Estimates of probabilities of survival, l_x, for males in presence of AIDS in Zimbabwe for the period 1990-1999. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	1	1	1	1	1	1	1	1	1	1
1	0.948	0.948	0.947	0.945	0.942	0.938	0.934	0.93	0.928	0.926
2	0.937	0.937	0.937	0.935	0.932	0.928	0.924	0.92	0.917	0.916
3	0.927	0.927	0.926	0.924	0.921	0.918	0.914	0.91	0.907	0.906
4	0.916	0.917	0.916	0.914	0.911	0.907	0.903	0.9	0.897	0.896
5	0.906	0.907	0.906	0.904	0.901	0.897	0.893	0.89	0.887	0.886
6	0.905	0.905	0.905	0.903	0.9	0.896	0.892	0.888	0.885	0.884
7	0.903	0.904	0.903	0.901	0.898	0.894	0.89	0.886	0.883	0.882
8	0.901	0.902	0.902	0.9	0.897	0.893	0.889	0.885	0.882	0.88
9	0.9	0.901	0.901	0.899	0.896	0.892	0.887	0.883	0.88	0.877
10	0.898	0.899	0.899	0.898	0.894	0.89	0.886	0.881	0.878	0.875
11	0.897	0.898	0.898	0.897	0.893	0.889	0.885	0.88	0.877	0.874
12	0.895	0.897	0.897	0.895	0.892	0.888	0.883	0.879	0.875	0.873
13	0.894	0.896	0.896	0.894	0.891	0.887	0.882	0.878	0.874	0.871
14	0.893	0.894	0.895	0.893	0.89	0.886	0.881	0.877	0.873	0.87
15	0.891	0.893	0.893	0.892	0.889	0.885	0.88	0.875	0.871	0.868
16	0.889	0.891	0.891	0.89	0.887	0.882	0.878	0.873	0.869	0.866
17	0.886	0.888	0.889	0.887	0.884	0.88	0.875	0.871	0.867	0.863
18	0.884	0.886	0.886	0.885	0.882	0.878	0.873	0.868	0.864	0.861
19	0.882	0.884	0.884	0.883	0.88	0.875	0.871	0.866	0.862	0.859
20	0.879	0.881	0.882	0.88	0.877	0.873	0.868	0.864	0.86	0.856
21	0.876	0.877	0.877	0.875	0.871	0.866	0.861	0.856	0.851	0.848
22	0.872	0.873	0.873	0.87	0.865	0.859	0.853	0.848	0.843	0.841
23	0.868	0.869	0.868	0.865	0.859	0.853	0.846	0.84	0.836	0.833
24	0.864	0.865	0.864	0.86	0.853	0.846	0.839	0.832	0.828	0.825
25	0.861	0.861	0.859	0.855	0.848	0.84	0.832	0.825	0.82	0.817
26	0.857	0.856	0.853	0.847	0.837	0.827	0.816	0.807	0.801	0.798
27	0.853	0.852	0.847	0.839	0.827	0.814	0.802	0.791	0.783	0.778
28	0.849	0.847	0.841	0.831	0.818	0.802	0.787	0.774	0.765	0.759
29	0.844	0.842	0.836	0.824	0.808	0.79	0.773	0.758	0.747	0.741
30	0.84	0.837	0.83	0.816	0.798	0.778	0.758	0.742	0.73	0.723
31	0.836	0.832	0.823	0.808	0.787	0.764	0.742	0.722	0.707	0.698
32	0.832	0.827	0.817	0.799	0.776	0.751	0.725	0.703	0.686	0.674
33	0.827	0.822	0.81	0.791	0.765	0.737	0.709	0.684	0.664	0.65

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AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
34	0.823	0.817	0.804	0.782	0.755	0.724	0.694	0.666	0.644	0.627
35	0.818	0.811	0.797	0.774	0.744	0.711	0.679	0.649	0.624	0.606
36	0.814	0.806	0.791	0.766	0.734	0.698	0.663	0.63	0.604	0.583
37	0.809	0.801	0.785	0.758	0.723	0.685	0.647	0.613	0.584	0.561
38	0.805	0.796	0.778	0.75	0.713	0.672	0.632	0.596	0.565	0.54
39	0.8	0.791	0.772	0.742	0.703	0.66	0.618	0.579	0.546	0.52
40	0.796	0.786	0.766	0.734	0.693	0.648	0.603	0.563	0.528	0.5
41	0.791	0.781	0.759	0.726	0.683	0.636	0.589	0.547	0.511	0.481
42	0.786	0.775	0.753	0.718	0.673	0.624	0.576	0.532	0.494	0.463
43	0.781	0.77	0.746	0.71	0.663	0.613	0.563	0.517	0.478	0.445
44	0.776	0.764	0.74	0.702	0.653	0.601	0.55	0.503	0.462	0.428
45	0.772	0.759	0.733	0.694	0.644	0.59	0.537	0.489	0.447	0.412
46	0.765	0.752	0.726	0.685	0.634	0.579	0.525	0.475	0.432	0.397
47	0.758	0.745	0.718	0.676	0.624	0.568	0.513	0.462	0.418	0.382
48	0.752	0.738	0.711	0.668	0.614	0.557	0.501	0.449	0.405	0.368
49	0.746	0.731	0.703	0.659	0.605	0.546	0.489	0.437	0.392	0.355
50	0.739	0.725	0.696	0.651	0.595	0.536	0.478	0.425	0.379	0.342
51	0.732	0.717	0.688	0.643	0.586	0.526	0.467	0.414	0.367	0.329
52	0.724	0.71	0.68	0.635	0.578	0.516	0.457	0.403	0.356	0.317
53	0.717	0.702	0.673	0.627	0.569	0.507	0.447	0.392	0.345	0.306
54	0.71	0.695	0.665	0.619	0.56	0.498	0.437	0.382	0.334	0.294
55	0.703	0.688	0.658	0.611	0.552	0.489	0.428	0.372	0.323	0.284
56	0.693	0.678	0.648	0.601	0.542	0.479	0.417	0.362	0.314	0.274
57	0.683	0.669	0.639	0.591	0.532	0.469	0.408	0.352	0.304	0.265
58	0.674	0.66	0.629	0.582	0.522	0.459	0.398	0.343	0.295	0.256
59	0.664	0.65	0.62	0.573	0.513	0.449	0.388	0.333	0.286	0.248
60	0.655	0.641	0.611	0.563	0.504	0.44	0.379	0.325	0.278	0.24
61	0.642	0.628	0.599	0.551	0.492	0.429	0.369	0.314	0.268	0.231
62	0.629	0.616	0.586	0.539	0.48	0.418	0.358	0.305	0.259	0.222
63	0.616	0.603	0.574	0.528	0.469	0.407	0.348	0.295	0.25	0.214
64	0.603	0.591	0.562	0.516	0.458	0.397	0.338	0.286	0.242	0.206
65	0.591	0.579	0.551	0.505	0.447	0.387	0.329	0.277	0.234	0.199
66	0.572	0.561	0.534	0.489	0.433	0.374	0.317	0.267	0.225	0.191
67	0.554	0.543	0.517	0.474	0.419	0.361	0.306	0.257	0.216	0.183
68	0.537	0.526	0.501	0.459	0.405	0.349	0.295	0.248	0.207	0.175
69	0.52	0.51	0.485	0.444	0.392	0.337	0.285	0.238	0.199	0.168

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AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
70	0.503	0.494	0.47	0.43	0.38	0.326	0.275	0.229	0.191	0.161
71	0.48	0.471	0.448	0.41	0.361	0.309	0.26	0.217	0.181	0.152
72	0.458	0.449	0.427	0.39	0.343	0.293	0.247	0.205	0.171	0.143
73	0.437	0.429	0.407	0.371	0.326	0.278	0.234	0.194	0.161	0.135
74	0.417	0.409	0.388	0.353	0.31	0.264	0.221	0.184	0.152	0.127
75	0.397	0.39	0.37	0.337	0.294	0.25	0.209	0.174	0.144	0.12
76	0.364	0.357	0.339	0.309	0.271	0.231	0.193	0.16	0.133	0.111
77	0.333	0.327	0.311	0.284	0.249	0.213	0.178	0.148	0.122	0.102
78	0.304	0.3	0.285	0.261	0.229	0.196	0.164	0.137	0.113	0.094
79	0.278	0.274	0.261	0.239	0.211	0.181	0.152	0.126	0.104	0.087
80	0.255	0.251	0.24	0.22	0.194	0.166	0.14	0.116	0.096	0.08
∞	0	0	0	0	0	0	0	0	0	0

Table A.24: Estimates of probabilities of survival, l_x, for males in presence of AIDS in Zimbabwe for the period 2000-2009. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	1	1	1	1	1	1	1	1	1	1
1	0.926	0.926	0.926	0.927	0.928	0.925	0.927	0.93	0.933	0.936
2	0.915	0.915	0.916	0.916	0.917	0.916	0.918	0.92	0.923	0.927
3	0.905	0.905	0.905	0.906	0.907	0.907	0.909	0.911	0.914	0.917
4	0.895	0.895	0.895	0.896	0.897	0.897	0.899	0.902	0.905	0.908
5	0.885	0.885	0.885	0.886	0.887	0.888	0.89	0.893	0.895	0.899
6	0.883	0.882	0.883	0.883	0.884	0.885	0.887	0.89	0.892	0.896
7	0.88	0.88	0.88	0.881	0.881	0.883	0.884	0.887	0.889	0.893
8	0.878	0.878	0.878	0.878	0.879	0.88	0.881	0.884	0.887	0.89
9	0.876	0.875	0.875	0.875	0.876	0.877	0.879	0.881	0.884	0.887
10	0.874	0.873	0.873	0.873	0.873	0.874	0.876	0.878	0.881	0.884
11	0.872	0.871	0.871	0.87	0.87	0.871	0.873	0.875	0.877	0.88
12	0.871	0.869	0.868	0.868	0.868	0.868	0.869	0.871	0.874	0.877
13	0.869	0.867	0.866	0.866	0.865	0.865	0.866	0.868	0.87	0.873
14	0.867	0.866	0.864	0.863	0.863	0.863	0.863	0.865	0.867	0.87
15	0.866	0.864	0.862	0.861	0.86	0.86	0.86	0.861	0.863	0.866
16	0.863	0.861	0.86	0.858	0.857	0.857	0.857	0.858	0.86	0.863
17	0.861	0.859	0.857	0.856	0.855	0.854	0.854	0.855	0.857	0.86
18	0.859	0.856	0.855	0.853	0.852	0.851	0.851	0.852	0.854	0.856
19	0.856	0.854	0.852	0.851	0.849	0.849	0.849	0.849	0.851	0.853
20	0.854	0.852	0.85	0.848	0.847	0.846	0.846	0.846	0.848	0.85
21	0.846	0.844	0.843	0.842	0.841	0.84	0.84	0.841	0.842	0.845
22	0.839	0.837	0.836	0.835	0.835	0.834	0.835	0.835	0.837	0.839
23	0.831	0.83	0.83	0.829	0.829	0.829	0.829	0.83	0.832	0.834
24	0.824	0.823	0.823	0.823	0.823	0.823	0.824	0.825	0.826	0.829
25	0.816	0.816	0.816	0.817	0.817	0.817	0.818	0.819	0.821	0.824
26	0.796	0.796	0.797	0.799	0.8	0.802	0.804	0.807	0.809	0.812
27	0.777	0.777	0.779	0.781	0.784	0.787	0.791	0.794	0.797	0.801
28	0.757	0.758	0.76	0.764	0.768	0.773	0.777	0.782	0.786	0.79
29	0.739	0.74	0.743	0.747	0.753	0.758	0.764	0.77	0.774	0.778
30	0.72	0.721	0.725	0.731	0.737	0.744	0.751	0.758	0.763	0.768
31	0.693	0.692	0.695	0.701	0.709	0.718	0.727	0.736	0.743	0.748
32	0.667	0.664	0.666	0.672	0.681	0.692	0.703	0.714	0.723	0.73
33	0.641	0.637	0.638	0.644	0.654	0.667	0.681	0.693	0.704	0.712

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AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
34	0.617	0.611	0.612	0.618	0.629	0.643	0.659	0.673	0.685	0.694
35	0.593	0.587	0.586	0.592	0.604	0.62	0.637	0.654	0.667	0.677
36	0.568	0.56	0.558	0.564	0.576	0.592	0.611	0.629	0.643	0.654
37	0.545	0.535	0.532	0.536	0.548	0.565	0.585	0.604	0.621	0.633
38	0.522	0.511	0.506	0.51	0.522	0.54	0.561	0.581	0.599	0.612
39	0.5	0.487	0.482	0.486	0.497	0.515	0.537	0.559	0.577	0.592
40	0.479	0.465	0.459	0.462	0.474	0.492	0.515	0.537	0.557	0.572
41	0.459	0.444	0.437	0.439	0.451	0.469	0.492	0.516	0.536	0.552
42	0.439	0.423	0.415	0.417	0.429	0.447	0.471	0.495	0.516	0.532
43	0.42	0.403	0.395	0.396	0.408	0.427	0.45	0.475	0.497	0.514
44	0.403	0.385	0.375	0.377	0.388	0.407	0.431	0.456	0.478	0.496
45	0.385	0.367	0.357	0.358	0.369	0.388	0.412	0.438	0.46	0.478
46	0.37	0.35	0.34	0.341	0.351	0.37	0.394	0.42	0.443	0.462
47	0.354	0.335	0.324	0.324	0.335	0.353	0.378	0.404	0.427	0.446
48	0.34	0.32	0.309	0.309	0.319	0.337	0.362	0.388	0.411	0.43
49	0.326	0.305	0.294	0.294	0.304	0.322	0.346	0.372	0.396	0.415
50	0.313	0.292	0.281	0.28	0.29	0.308	0.331	0.358	0.381	0.401
51	0.3	0.279	0.268	0.267	0.277	0.295	0.318	0.344	0.367	0.387
52	0.287	0.267	0.256	0.255	0.265	0.282	0.305	0.331	0.354	0.373
53	0.276	0.255	0.244	0.244	0.253	0.27	0.293	0.318	0.341	0.36
54	0.264	0.244	0.233	0.233	0.242	0.259	0.281	0.306	0.328	0.347
55	0.253	0.233	0.222	0.222	0.231	0.248	0.27	0.294	0.316	0.335
56	0.244	0.224	0.213	0.212	0.221	0.237	0.258	0.282	0.305	0.324
57	0.235	0.215	0.204	0.202	0.211	0.226	0.247	0.271	0.294	0.313
58	0.227	0.206	0.195	0.193	0.201	0.216	0.237	0.26	0.283	0.302
59	0.219	0.198	0.187	0.185	0.192	0.206	0.227	0.25	0.273	0.292
60	0.211	0.19	0.179	0.176	0.183	0.197	0.217	0.24	0.263	0.282
61	0.202	0.182	0.171	0.169	0.175	0.189	0.208	0.231	0.252	0.271
62	0.194	0.175	0.164	0.162	0.168	0.181	0.2	0.222	0.243	0.261
63	0.187	0.168	0.157	0.155	0.161	0.174	0.192	0.213	0.233	0.251
64	0.179	0.161	0.15	0.148	0.154	0.166	0.184	0.204	0.224	0.241
65	0.172	0.154	0.144	0.142	0.148	0.159	0.176	0.196	0.215	0.232
66	0.165	0.147	0.137	0.135	0.14	0.152	0.168	0.187	0.206	0.222
67	0.158	0.14	0.131	0.129	0.134	0.145	0.161	0.179	0.197	0.213
68	0.151	0.134	0.124	0.122	0.127	0.138	0.153	0.171	0.189	0.205
69	0.144	0.128	0.118	0.116	0.121	0.131	0.146	0.164	0.181	0.196

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AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
70	0.138	0.122	0.113	0.111	0.115	0.125	0.139	0.157	0.173	0.188
71	0.13	0.115	0.106	0.104	0.108	0.117	0.131	0.147	0.163	0.178
72	0.122	0.108	0.1	0.098	0.102	0.11	0.123	0.138	0.153	0.167
73	0.115	0.102	0.094	0.092	0.095	0.103	0.115	0.13	0.144	0.158
74	0.109	0.096	0.088	0.086	0.089	0.097	0.108	0.122	0.136	0.149
75	0.103	0.09	0.083	0.081	0.084	0.091	0.102	0.115	0.128	0.14
76	0.094	0.083	0.076	0.074	0.077	0.084	0.093	0.105	0.117	0.129
77	0.087	0.076	0.07	0.068	0.071	0.077	0.086	0.097	0.108	0.118
78	0.08	0.07	0.064	0.062	0.065	0.07	0.078	0.089	0.099	0.109
79	0.073	0.064	0.059	0.057	0.059	0.064	0.072	0.081	0.091	0.1
80	0.068	0.059	0.054	0.053	0.054	0.059	0.066	0.075	0.083	0.092
∞	0	0	0	0	0	0	0	0	0	0

Table A.25: Projections of probabilities of survival, l_x, for males in presence of AIDS in Zimbabwe for the period 2010-2019. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0	1	1	1	1	1	1	1	1	1	1
1	0.933	0.936	0.94	0.943	0.947	0.943	0.946	0.949	0.951	0.954
2	0.925	0.928	0.932	0.935	0.939	0.937	0.94	0.942	0.945	0.947
3	0.917	0.921	0.924	0.928	0.931	0.931	0.934	0.936	0.939	0.941
4	0.909	0.913	0.916	0.92	0.923	0.924	0.927	0.93	0.933	0.935
5	0.902	0.905	0.909	0.912	0.915	0.918	0.921	0.924	0.926	0.929
6	0.899	0.902	0.906	0.909	0.913	0.916	0.919	0.922	0.925	0.927
7	0.896	0.9	0.903	0.907	0.91	0.914	0.917	0.92	0.923	0.925
8	0.893	0.897	0.901	0.904	0.908	0.912	0.915	0.918	0.921	0.923
9	0.89	0.894	0.898	0.902	0.906	0.909	0.913	0.916	0.919	0.921
10	0.888	0.891	0.895	0.899	0.903	0.907	0.911	0.914	0.917	0.92
11	0.884	0.888	0.892	0.896	0.9	0.904	0.908	0.911	0.914	0.917
12	0.88	0.884	0.888	0.893	0.897	0.901	0.905	0.908	0.911	0.914
13	0.877	0.881	0.885	0.889	0.893	0.898	0.902	0.905	0.909	0.911
14	0.873	0.877	0.881	0.886	0.89	0.894	0.899	0.902	0.906	0.909
15	0.87	0.874	0.878	0.882	0.887	0.891	0.896	0.899	0.903	0.906
16	0.866	0.87	0.874	0.879	0.883	0.888	0.892	0.896	0.899	0.902
17	0.863	0.867	0.871	0.875	0.88	0.884	0.888	0.892	0.896	0.899
18	0.86	0.863	0.867	0.872	0.876	0.88	0.885	0.889	0.892	0.895
19	0.856	0.86	0.864	0.868	0.873	0.877	0.881	0.885	0.889	0.892
20	0.853	0.857	0.86	0.865	0.869	0.873	0.877	0.881	0.885	0.888
21	0.848	0.851	0.855	0.859	0.864	0.868	0.872	0.876	0.88	0.884
22	0.842	0.846	0.85	0.854	0.859	0.863	0.867	0.872	0.875	0.879
23	0.837	0.841	0.845	0.849	0.853	0.858	0.862	0.867	0.871	0.874
24	0.832	0.835	0.839	0.844	0.848	0.853	0.857	0.862	0.866	0.87
25	0.827	0.83	0.834	0.839	0.843	0.848	0.852	0.857	0.861	0.865
26	0.815	0.819	0.823	0.827	0.832	0.837	0.842	0.847	0.851	0.855
27	0.804	0.808	0.812	0.816	0.821	0.826	0.832	0.837	0.841	0.846
28	0.793	0.797	0.801	0.806	0.811	0.816	0.821	0.827	0.832	0.836
29	0.782	0.786	0.79	0.795	0.8	0.806	0.811	0.817	0.822	0.827
30	0.772	0.775	0.78	0.784	0.79	0.795	0.801	0.807	0.813	0.818
31	0.753	0.758	0.762	0.767	0.773	0.779	0.786	0.792	0.798	0.803
32	0.735	0.74	0.745	0.75	0.757	0.763	0.77	0.777	0.783	0.789
33	0.718	0.723	0.728	0.734	0.741	0.748	0.755	0.762	0.768	0.774

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AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
34	0.701	0.707	0.712	0.718	0.725	0.732	0.74	0.747	0.754	0.76
35	0.684	0.69	0.696	0.702	0.71	0.717	0.725	0.733	0.74	0.747
36	0.663	0.67	0.676	0.683	0.691	0.699	0.707	0.715	0.723	0.73
37	0.642	0.65	0.657	0.664	0.673	0.681	0.69	0.698	0.706	0.713
38	0.622	0.63	0.638	0.646	0.655	0.664	0.673	0.682	0.69	0.697
39	0.602	0.611	0.62	0.628	0.638	0.647	0.656	0.665	0.674	0.682
40	0.584	0.593	0.602	0.611	0.621	0.631	0.64	0.65	0.658	0.666
41	0.564	0.574	0.583	0.593	0.603	0.613	0.623	0.632	0.641	0.65
42	0.545	0.556	0.565	0.575	0.585	0.595	0.606	0.616	0.625	0.634
43	0.527	0.538	0.548	0.558	0.568	0.578	0.589	0.599	0.609	0.618
44	0.509	0.521	0.531	0.541	0.551	0.562	0.573	0.583	0.593	0.603
45	0.492	0.504	0.514	0.524	0.535	0.546	0.557	0.568	0.578	0.588
46	0.476	0.488	0.498	0.509	0.52	0.531	0.542	0.553	0.563	0.573
47	0.46	0.472	0.483	0.494	0.504	0.515	0.527	0.537	0.548	0.558
48	0.445	0.457	0.468	0.479	0.49	0.501	0.512	0.523	0.533	0.543
49	0.43	0.443	0.454	0.464	0.475	0.486	0.498	0.509	0.519	0.529
50	0.416	0.429	0.44	0.451	0.461	0.473	0.484	0.495	0.505	0.516
51	0.402	0.415	0.426	0.437	0.448	0.46	0.471	0.482	0.492	0.502
52	0.389	0.402	0.413	0.425	0.436	0.447	0.458	0.469	0.479	0.489
53	0.376	0.389	0.401	0.412	0.423	0.435	0.445	0.456	0.466	0.476
54	0.363	0.377	0.389	0.4	0.411	0.423	0.433	0.444	0.454	0.463
55	0.351	0.365	0.377	0.388	0.4	0.411	0.422	0.432	0.442	0.451
56	0.34	0.353	0.365	0.377	0.388	0.399	0.41	0.42	0.43	0.439
57	0.329	0.342	0.355	0.366	0.377	0.388	0.398	0.408	0.418	0.428
58	0.318	0.332	0.344	0.355	0.366	0.377	0.387	0.397	0.407	0.416
59	0.308	0.322	0.334	0.345	0.355	0.366	0.376	0.386	0.396	0.405
60	0.298	0.312	0.324	0.334	0.345	0.355	0.365	0.375	0.385	0.395
61	0.287	0.301	0.313	0.324	0.334	0.345	0.355	0.364	0.374	0.383
62	0.276	0.29	0.302	0.313	0.324	0.334	0.344	0.354	0.363	0.372
63	0.266	0.28	0.292	0.303	0.314	0.324	0.334	0.343	0.352	0.361
64	0.256	0.27	0.282	0.294	0.305	0.315	0.324	0.333	0.342	0.35
65	0.247	0.26	0.273	0.284	0.295	0.305	0.315	0.323	0.332	0.34
66	0.237	0.25	0.262	0.273	0.283	0.293	0.302	0.31	0.319	0.327
67	0.228	0.24	0.251	0.262	0.271	0.28	0.289	0.298	0.307	0.315
68	0.218	0.231	0.241	0.251	0.26	0.269	0.278	0.286	0.295	0.304
69	0.21	0.222	0.232	0.241	0.249	0.258	0.266	0.275	0.284	0.293

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AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
70	0.201	0.213	0.223	0.231	0.239	0.247	0.255	0.264	0.273	0.282
71	0.19	0.201	0.211	0.219	0.227	0.234	0.242	0.25	0.258	0.266
72	0.18	0.19	0.2	0.208	0.216	0.223	0.23	0.237	0.244	0.251
73	0.169	0.18	0.189	0.197	0.205	0.211	0.218	0.224	0.231	0.237
74	0.16	0.17	0.179	0.187	0.194	0.201	0.207	0.212	0.218	0.224
75	0.151	0.161	0.17	0.178	0.184	0.19	0.196	0.201	0.206	0.212
76	0.139	0.148	0.157	0.164	0.17	0.176	0.181	0.185	0.19	0.195
77	0.128	0.137	0.144	0.151	0.157	0.162	0.166	0.171	0.175	0.18
78	0.118	0.126	0.133	0.139	0.145	0.149	0.153	0.157	0.162	0.166
79	0.108	0.116	0.123	0.129	0.133	0.138	0.141	0.145	0.149	0.153
80	0.1	0.107	0.113	0.119	0.123	0.127	0.13	0.134	0.137	0.141
∞	0	0	0	0	0	0	0	0	0	0

Table A.26: Projections of probabilities of survival, l_x, for males in presence of AIDS in Zimbabwe for the period 2020-2029. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
0	1	1	1	1	1	1	1	1	1	1
1	0.951	0.953	0.955	0.957	0.959	0.957	0.958	0.96	0.961	0.963
2	0.946	0.948	0.95	0.952	0.953	0.953	0.954	0.955	0.957	0.958
3	0.941	0.943	0.945	0.947	0.948	0.948	0.95	0.951	0.953	0.954
4	0.936	0.938	0.94	0.942	0.943	0.944	0.945	0.947	0.948	0.95
5	0.931	0.933	0.935	0.936	0.938	0.94	0.941	0.942	0.944	0.945
6	0.929	0.931	0.933	0.935	0.936	0.938	0.94	0.941	0.943	0.944
7	0.927	0.929	0.931	0.933	0.935	0.937	0.938	0.94	0.941	0.943
8	0.926	0.928	0.93	0.931	0.933	0.935	0.937	0.939	0.94	0.942
9	0.924	0.926	0.928	0.93	0.932	0.934	0.935	0.937	0.939	0.94
10	0.922	0.924	0.926	0.928	0.93	0.932	0.934	0.936	0.938	0.939
11	0.919	0.922	0.924	0.926	0.928	0.93	0.932	0.934	0.936	0.937
12	0.917	0.919	0.921	0.924	0.926	0.928	0.93	0.932	0.934	0.936
13	0.914	0.916	0.919	0.921	0.924	0.926	0.928	0.931	0.933	0.934
14	0.911	0.914	0.916	0.919	0.921	0.924	0.927	0.929	0.931	0.933
15	0.909	0.911	0.914	0.917	0.919	0.922	0.925	0.927	0.929	0.931
16	0.905	0.908	0.911	0.913	0.916	0.919	0.922	0.924	0.927	0.929
17	0.902	0.905	0.907	0.91	0.913	0.916	0.919	0.922	0.924	0.926
18	0.898	0.901	0.904	0.907	0.91	0.913	0.916	0.919	0.921	0.924
19	0.895	0.898	0.901	0.904	0.907	0.91	0.913	0.916	0.919	0.921
20	0.892	0.895	0.898	0.901	0.904	0.907	0.911	0.914	0.916	0.919
21	0.887	0.89	0.893	0.896	0.9	0.903	0.906	0.909	0.912	0.914
22	0.882	0.885	0.889	0.892	0.895	0.899	0.902	0.905	0.908	0.91
23	0.878	0.881	0.884	0.887	0.891	0.894	0.897	0.9	0.903	0.906
24	0.873	0.876	0.88	0.883	0.886	0.89	0.893	0.896	0.899	0.902
25	0.868	0.872	0.875	0.879	0.882	0.885	0.889	0.892	0.895	0.897
26	0.859	0.863	0.866	0.87	0.873	0.876	0.88	0.883	0.886	0.888
27	0.85	0.853	0.857	0.861	0.864	0.868	0.871	0.874	0.877	0.88
28	0.841	0.844	0.848	0.852	0.855	0.859	0.862	0.865	0.868	0.871
29	0.831	0.835	0.839	0.843	0.847	0.85	0.853	0.857	0.86	0.862
30	0.822	0.827	0.831	0.834	0.838	0.841	0.845	0.848	0.851	0.854
31	0.808	0.812	0.817	0.821	0.825	0.828	0.832	0.835	0.838	0.841
32	0.794	0.799	0.803	0.807	0.811	0.815	0.819	0.822	0.825	0.828
33	0.78	0.785	0.79	0.794	0.798	0.802	0.806	0.809	0.813	0.816

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AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
34	0.766	0.771	0.776	0.781	0.785	0.789	0.793	0.797	0.8	0.803
35	0.753	0.758	0.763	0.768	0.773	0.777	0.781	0.784	0.788	0.791
36	0.736	0.742	0.747	0.752	0.757	0.762	0.766	0.77	0.773	0.777
37	0.72	0.726	0.732	0.737	0.742	0.747	0.751	0.755	0.759	0.762
38	0.704	0.711	0.717	0.722	0.727	0.732	0.737	0.741	0.745	0.748
39	0.689	0.695	0.702	0.707	0.713	0.718	0.722	0.727	0.731	0.735
40	0.674	0.681	0.687	0.693	0.698	0.704	0.708	0.713	0.717	0.721
41	0.658	0.665	0.671	0.678	0.683	0.689	0.694	0.698	0.703	0.707
42	0.642	0.649	0.656	0.663	0.669	0.674	0.679	0.684	0.689	0.693
43	0.626	0.634	0.641	0.648	0.654	0.66	0.665	0.67	0.675	0.679
44	0.611	0.619	0.627	0.634	0.64	0.646	0.652	0.657	0.661	0.666
45	0.597	0.605	0.612	0.62	0.626	0.632	0.638	0.643	0.648	0.652
46	0.582	0.59	0.598	0.605	0.612	0.618	0.624	0.629	0.634	0.639
47	0.567	0.576	0.584	0.591	0.598	0.604	0.61	0.616	0.621	0.625
48	0.553	0.562	0.57	0.577	0.584	0.591	0.597	0.602	0.607	0.612
49	0.539	0.548	0.556	0.564	0.571	0.578	0.584	0.589	0.594	0.599
50	0.525	0.534	0.543	0.551	0.558	0.565	0.571	0.576	0.582	0.587
51	0.512	0.521	0.529	0.537	0.544	0.551	0.557	0.563	0.569	0.574
52	0.498	0.507	0.516	0.524	0.531	0.538	0.545	0.551	0.556	0.562
53	0.485	0.494	0.503	0.51	0.518	0.525	0.532	0.538	0.544	0.549
54	0.473	0.481	0.49	0.498	0.505	0.513	0.519	0.526	0.532	0.537
55	0.46	0.469	0.477	0.485	0.493	0.5	0.507	0.514	0.52	0.526
56	0.448	0.457	0.465	0.473	0.481	0.488	0.495	0.502	0.508	0.513
57	0.437	0.445	0.453	0.461	0.469	0.476	0.483	0.49	0.496	0.501
58	0.425	0.434	0.442	0.45	0.457	0.464	0.471	0.478	0.484	0.489
59	0.414	0.423	0.431	0.438	0.446	0.453	0.46	0.466	0.472	0.478
60	0.403	0.412	0.42	0.427	0.435	0.442	0.449	0.455	0.461	0.466
61	0.392	0.4	0.408	0.416	0.423	0.43	0.437	0.443	0.448	0.453
62	0.38	0.388	0.396	0.404	0.411	0.418	0.425	0.431	0.436	0.441
63	0.369	0.377	0.385	0.393	0.4	0.407	0.413	0.419	0.424	0.429
64	0.358	0.366	0.374	0.382	0.389	0.396	0.402	0.408	0.413	0.417
65	0.348	0.356	0.364	0.371	0.378	0.385	0.391	0.397	0.401	0.406
66	0.335	0.343	0.351	0.358	0.365	0.371	0.377	0.383	0.388	0.392
67	0.323	0.331	0.339	0.346	0.352	0.358	0.364	0.369	0.374	0.379
68	0.312	0.32	0.327	0.334	0.34	0.346	0.351	0.356	0.361	0.366
69	0.301	0.308	0.315	0.322	0.328	0.334	0.339	0.344	0.349	0.353

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AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
70	0.29	0.298	0.304	0.311	0.316	0.322	0.327	0.332	0.337	0.341
71	0.274	0.282	0.289	0.295	0.301	0.306	0.312	0.316	0.321	0.325
72	0.259	0.266	0.273	0.28	0.286	0.292	0.297	0.301	0.305	0.309
73	0.244	0.252	0.259	0.266	0.272	0.278	0.283	0.287	0.29	0.294
74	0.231	0.238	0.246	0.253	0.259	0.264	0.269	0.273	0.277	0.28
75	0.218	0.225	0.233	0.24	0.246	0.252	0.256	0.26	0.263	0.266
76	0.201	0.208	0.215	0.222	0.228	0.233	0.237	0.241	0.244	0.247
77	0.186	0.192	0.198	0.205	0.21	0.216	0.22	0.223	0.227	0.229
78	0.171	0.177	0.183	0.189	0.195	0.199	0.204	0.207	0.21	0.213
79	0.158	0.163	0.169	0.175	0.18	0.184	0.189	0.192	0.195	0.197
80	0.146	0.151	0.156	0.161	0.166	0.171	0.175	0.178	0.181	0.183
∞	0	0	0	0	0	0	0	0	0	0

Table A.27: Projections of probabilities of survival, l_x, for males in presence of AIDS in Zimbabwe for the period 2030-2039. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
0	1	1	1	1	1	1	1	1	1	1
1	0.961	0.962	0.963	0.965	0.966	0.964	0.965	0.966	0.968	0.969
2	0.957	0.959	0.96	0.961	0.962	0.961	0.962	0.963	0.964	0.965
3	0.954	0.955	0.956	0.957	0.958	0.958	0.959	0.96	0.961	0.962
4	0.95	0.951	0.953	0.954	0.955	0.955	0.956	0.957	0.958	0.959
5	0.946	0.948	0.949	0.95	0.951	0.952	0.953	0.954	0.955	0.956
6	0.945	0.947	0.948	0.949	0.95	0.951	0.952	0.953	0.954	0.955
7	0.944	0.945	0.947	0.948	0.949	0.95	0.951	0.952	0.953	0.954
8	0.943	0.944	0.945	0.947	0.948	0.949	0.95	0.951	0.952	0.953
9	0.942	0.943	0.944	0.946	0.947	0.948	0.949	0.95	0.951	0.952
10	0.941	0.942	0.943	0.945	0.946	0.947	0.948	0.949	0.95	0.952
11	0.939	0.94	0.942	0.943	0.944	0.946	0.947	0.948	0.949	0.95
12	0.937	0.939	0.94	0.941	0.943	0.944	0.945	0.947	0.948	0.949
13	0.936	0.937	0.939	0.94	0.941	0.943	0.944	0.945	0.946	0.948
14	0.934	0.936	0.937	0.938	0.94	0.941	0.943	0.944	0.945	0.946
15	0.933	0.934	0.936	0.937	0.938	0.94	0.941	0.942	0.944	0.945
16	0.93	0.932	0.933	0.935	0.936	0.938	0.939	0.941	0.942	0.943
17	0.928	0.93	0.931	0.933	0.934	0.936	0.937	0.939	0.94	0.941
18	0.926	0.927	0.929	0.93	0.932	0.934	0.935	0.937	0.938	0.939
19	0.923	0.925	0.927	0.928	0.93	0.931	0.933	0.935	0.936	0.937
20	0.921	0.923	0.924	0.926	0.928	0.929	0.931	0.933	0.934	0.936
21	0.917	0.918	0.92	0.922	0.924	0.926	0.927	0.929	0.931	0.932
22	0.912	0.914	0.916	0.918	0.92	0.922	0.924	0.926	0.927	0.929
23	0.908	0.91	0.912	0.914	0.916	0.918	0.92	0.922	0.924	0.925
24	0.904	0.906	0.908	0.91	0.912	0.914	0.917	0.918	0.92	0.922
25	0.9	0.902	0.904	0.906	0.909	0.911	0.913	0.915	0.917	0.919
26	0.891	0.893	0.896	0.898	0.901	0.903	0.905	0.908	0.91	0.912
27	0.882	0.885	0.887	0.89	0.893	0.895	0.898	0.9	0.903	0.905
28	0.874	0.876	0.879	0.882	0.885	0.887	0.89	0.893	0.895	0.898
29	0.865	0.868	0.871	0.874	0.877	0.88	0.883	0.886	0.888	0.891
30	0.857	0.86	0.863	0.866	0.869	0.872	0.875	0.878	0.881	0.884
31	0.844	0.847	0.85	0.853	0.857	0.86	0.863	0.867	0.87	0.873
32	0.831	0.835	0.838	0.841	0.844	0.848	0.852	0.855	0.859	0.862
33	0.819	0.822	0.825	0.829	0.832	0.836	0.84	0.844	0.848	0.851

Continued on next page

AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
34	0.807	0.81	0.813	0.817	0.821	0.824	0.828	0.832	0.837	0.841
35	0.795	0.798	0.801	0.805	0.809	0.813	0.817	0.821	0.826	0.83
36	0.78	0.784	0.787	0.791	0.795	0.799	0.803	0.808	0.812	0.817
37	0.766	0.77	0.773	0.777	0.781	0.785	0.79	0.794	0.799	0.804
38	0.752	0.756	0.76	0.763	0.767	0.772	0.776	0.781	0.786	0.791
39	0.738	0.742	0.746	0.75	0.754	0.759	0.763	0.768	0.773	0.779
40	0.725	0.729	0.733	0.737	0.741	0.746	0.75	0.755	0.761	0.766
41	0.711	0.715	0.719	0.723	0.727	0.732	0.737	0.742	0.748	0.753
42	0.697	0.701	0.705	0.709	0.714	0.718	0.724	0.729	0.735	0.741
43	0.683	0.687	0.691	0.696	0.7	0.705	0.711	0.716	0.722	0.728
44	0.67	0.674	0.678	0.682	0.687	0.692	0.698	0.704	0.71	0.716
45	0.657	0.661	0.665	0.669	0.674	0.68	0.685	0.691	0.697	0.704
46	0.643	0.647	0.652	0.656	0.661	0.667	0.672	0.678	0.685	0.692
47	0.63	0.634	0.639	0.643	0.649	0.654	0.66	0.666	0.673	0.679
48	0.617	0.621	0.626	0.631	0.636	0.642	0.647	0.654	0.66	0.667
49	0.604	0.609	0.613	0.618	0.624	0.629	0.635	0.642	0.648	0.656
50	0.592	0.596	0.601	0.606	0.612	0.617	0.623	0.63	0.637	0.644
51	0.579	0.584	0.589	0.594	0.599	0.605	0.611	0.618	0.625	0.632
52	0.567	0.572	0.576	0.582	0.587	0.593	0.599	0.606	0.613	0.62
53	0.555	0.559	0.564	0.57	0.575	0.581	0.587	0.594	0.601	0.609
54	0.543	0.548	0.553	0.558	0.563	0.569	0.576	0.582	0.59	0.597
55	0.531	0.536	0.541	0.546	0.552	0.558	0.564	0.571	0.578	0.586
56	0.519	0.524	0.529	0.534	0.54	0.546	0.552	0.559	0.567	0.575
57	0.506	0.511	0.517	0.522	0.528	0.534	0.541	0.548	0.556	0.564
58	0.494	0.499	0.505	0.511	0.517	0.523	0.53	0.537	0.544	0.553
59	0.483	0.488	0.493	0.499	0.505	0.512	0.519	0.526	0.534	0.542
60	0.471	0.476	0.482	0.488	0.494	0.501	0.508	0.515	0.523	0.531
61	0.458	0.463	0.469	0.475	0.481	0.488	0.495	0.502	0.51	0.519
62	0.446	0.451	0.456	0.462	0.468	0.475	0.482	0.49	0.498	0.506
63	0.434	0.439	0.444	0.45	0.456	0.463	0.47	0.478	0.486	0.495
64	0.422	0.427	0.432	0.437	0.444	0.451	0.458	0.466	0.474	0.483
65	0.41	0.415	0.42	0.426	0.432	0.439	0.446	0.454	0.463	0.472
66	0.396	0.401	0.406	0.412	0.418	0.424	0.432	0.439	0.448	0.456
67	0.383	0.388	0.392	0.398	0.404	0.41	0.417	0.425	0.433	0.442
68	0.37	0.375	0.379	0.385	0.39	0.397	0.404	0.411	0.419	0.427
69	0.358	0.362	0.367	0.372	0.377	0.384	0.39	0.398	0.405	0.414

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AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
70	0.345	0.35	0.354	0.359	0.365	0.371	0.377	0.385	0.392	0.4
71	0.329	0.333	0.338	0.343	0.348	0.354	0.36	0.367	0.375	0.382
72	0.313	0.317	0.322	0.327	0.332	0.338	0.344	0.351	0.358	0.365
73	0.298	0.302	0.306	0.311	0.317	0.323	0.329	0.335	0.342	0.349
74	0.283	0.287	0.292	0.297	0.302	0.308	0.314	0.32	0.327	0.333
75	0.27	0.273	0.278	0.283	0.288	0.294	0.3	0.306	0.312	0.319
76	0.25	0.254	0.258	0.262	0.267	0.273	0.279	0.285	0.291	0.297
77	0.232	0.235	0.239	0.243	0.248	0.254	0.259	0.265	0.271	0.277
78	0.215	0.218	0.222	0.226	0.23	0.236	0.241	0.247	0.252	0.258
79	0.2	0.202	0.206	0.209	0.214	0.219	0.224	0.229	0.235	0.24
80	0.185	0.188	0.191	0.194	0.198	0.203	0.208	0.214	0.219	0.224
∞	0	0	0	0	0	0	0	0	0	0

Table A.28: Projections of probabilities of survival, l_x, for males in presence of AIDS in Zimbabwe for the period 2040-2050. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
0	1	1	1	1	1	1	1	1	1	1	1
1	0.968	0.969	0.97	0.971	0.972	0.971	0.972	0.973	0.974	0.976	0.977
2	0.965	0.966	0.967	0.968	0.97	0.969	0.97	0.971	0.972	0.973	0.974
3	0.963	0.964	0.965	0.966	0.967	0.967	0.968	0.969	0.97	0.971	0.972
4	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.97
5	0.957	0.958	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968
6	0.956	0.957	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967
7	0.955	0.957	0.958	0.959	0.96	0.961	0.962	0.963	0.964	0.966	0.967
8	0.954	0.956	0.957	0.958	0.959	0.96	0.961	0.963	0.964	0.965	0.966
9	0.954	0.955	0.956	0.957	0.958	0.959	0.961	0.962	0.963	0.964	0.966
10	0.953	0.954	0.955	0.956	0.957	0.958	0.96	0.961	0.962	0.964	0.965
11	0.951	0.952	0.954	0.955	0.956	0.957	0.959	0.96	0.961	0.962	0.964
12	0.95	0.951	0.952	0.954	0.955	0.956	0.957	0.959	0.96	0.961	0.963
13	0.949	0.95	0.951	0.952	0.954	0.955	0.956	0.957	0.959	0.96	0.961
14	0.948	0.949	0.95	0.951	0.953	0.954	0.955	0.956	0.958	0.959	0.96
15	0.946	0.948	0.949	0.95	0.951	0.953	0.954	0.955	0.956	0.958	0.959
16	0.944	0.946	0.947	0.948	0.95	0.951	0.952	0.953	0.955	0.956	0.957
17	0.943	0.944	0.945	0.947	0.948	0.949	0.95	0.952	0.953	0.954	0.956
18	0.941	0.942	0.943	0.945	0.946	0.947	0.949	0.95	0.951	0.953	0.954
19	0.939	0.94	0.942	0.943	0.944	0.946	0.947	0.948	0.95	0.951	0.953
20	0.937	0.938	0.94	0.941	0.943	0.944	0.945	0.947	0.948	0.95	0.951
21	0.934	0.935	0.937	0.938	0.94	0.941	0.943	0.944	0.946	0.947	0.949
22	0.93	0.932	0.933	0.935	0.937	0.938	0.94	0.942	0.943	0.945	0.947
23	0.927	0.929	0.93	0.932	0.934	0.935	0.937	0.939	0.941	0.943	0.944
24	0.924	0.925	0.927	0.929	0.931	0.933	0.934	0.936	0.938	0.94	0.942
25	0.921	0.922	0.924	0.926	0.928	0.93	0.932	0.934	0.936	0.938	0.94
26	0.914	0.916	0.918	0.92	0.922	0.924	0.926	0.928	0.931	0.933	0.935
27	0.907	0.909	0.911	0.914	0.916	0.918	0.921	0.923	0.926	0.928	0.931
28	0.9	0.903	0.905	0.908	0.91	0.913	0.915	0.918	0.921	0.923	0.926
29	0.894	0.896	0.899	0.901	0.904	0.907	0.91	0.913	0.916	0.918	0.921
30	0.887	0.89	0.893	0.895	0.898	0.901	0.904	0.907	0.911	0.914	0.917
31	0.876	0.879	0.883	0.886	0.889	0.892	0.896	0.899	0.902	0.906	0.909
32	0.866	0.869	0.873	0.876	0.88	0.883	0.887	0.891	0.894	0.898	0.902
33	0.855	0.859	0.863	0.867	0.87	0.874	0.878	0.882	0.886	0.89	0.894

Continued on next page

AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
34	0.845	0.849	0.853	0.857	0.861	0.866	0.87	0.874	0.878	0.883	0.887
35	0.834	0.839	0.843	0.848	0.852	0.857	0.861	0.866	0.87	0.875	0.879
36	0.822	0.826	0.831	0.836	0.841	0.846	0.851	0.856	0.861	0.865	0.87
37	0.809	0.814	0.819	0.825	0.83	0.835	0.84	0.846	0.851	0.856	0.861
38	0.796	0.802	0.807	0.813	0.819	0.825	0.83	0.836	0.841	0.847	0.852
39	0.784	0.79	0.796	0.802	0.808	0.814	0.82	0.826	0.832	0.838	0.843
40	0.772	0.778	0.784	0.791	0.797	0.804	0.81	0.816	0.822	0.829	0.835
41	0.759	0.766	0.772	0.779	0.786	0.792	0.799	0.805	0.812	0.819	0.825
42	0.747	0.754	0.76	0.767	0.774	0.781	0.788	0.795	0.802	0.809	0.815
43	0.735	0.742	0.749	0.756	0.763	0.77	0.777	0.784	0.792	0.799	0.806
44	0.723	0.73	0.737	0.744	0.752	0.759	0.767	0.774	0.782	0.789	0.797
45	0.711	0.718	0.726	0.733	0.741	0.748	0.756	0.764	0.772	0.78	0.787
46	0.699	0.706	0.714	0.721	0.729	0.737	0.745	0.753	0.761	0.769	0.778
47	0.687	0.694	0.702	0.71	0.718	0.726	0.734	0.743	0.751	0.759	0.768
48	0.675	0.683	0.691	0.699	0.707	0.715	0.724	0.732	0.741	0.75	0.758
49	0.663	0.671	0.679	0.687	0.696	0.704	0.713	0.722	0.731	0.74	0.749
50	0.652	0.66	0.668	0.677	0.685	0.694	0.703	0.712	0.721	0.73	0.739
51	0.64	0.648	0.657	0.665	0.674	0.683	0.692	0.701	0.71	0.72	0.729
52	0.628	0.637	0.645	0.654	0.663	0.672	0.681	0.691	0.7	0.709	0.719
53	0.617	0.626	0.634	0.643	0.652	0.662	0.671	0.68	0.69	0.699	0.709
54	0.606	0.615	0.624	0.633	0.642	0.651	0.661	0.67	0.679	0.689	0.699
55	0.595	0.604	0.613	0.622	0.632	0.641	0.65	0.66	0.669	0.679	0.689
56	0.583	0.592	0.602	0.611	0.62	0.63	0.639	0.649	0.659	0.668	0.678
57	0.572	0.581	0.59	0.6	0.609	0.619	0.629	0.638	0.648	0.658	0.668
58	0.561	0.57	0.579	0.589	0.599	0.608	0.618	0.628	0.638	0.648	0.658
59	0.55	0.559	0.569	0.578	0.588	0.598	0.608	0.618	0.627	0.637	0.647
60	0.54	0.549	0.558	0.568	0.578	0.587	0.597	0.607	0.617	0.627	0.638
61	0.527	0.537	0.546	0.556	0.565	0.575	0.585	0.595	0.605	0.615	0.625
62	0.515	0.524	0.534	0.544	0.553	0.563	0.573	0.583	0.593	0.602	0.612
63	0.503	0.513	0.522	0.532	0.542	0.552	0.561	0.571	0.581	0.59	0.6
64	0.492	0.501	0.511	0.52	0.53	0.54	0.55	0.559	0.569	0.578	0.588
65	0.481	0.49	0.5	0.509	0.519	0.529	0.539	0.548	0.558	0.567	0.576
66	0.465	0.475	0.484	0.494	0.504	0.514	0.523	0.533	0.542	0.551	0.56
67	0.451	0.46	0.47	0.479	0.489	0.499	0.509	0.518	0.527	0.536	0.545
68	0.436	0.446	0.455	0.465	0.475	0.485	0.494	0.504	0.513	0.522	0.53
69	0.422	0.432	0.441	0.451	0.461	0.471	0.481	0.49	0.499	0.507	0.516

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AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
70	0.409	0.418	0.428	0.438	0.448	0.458	0.467	0.476	0.485	0.493	0.502
71	0.391	0.4	0.409	0.419	0.428	0.438	0.447	0.456	0.465	0.474	0.483
72	0.373	0.382	0.391	0.4	0.409	0.419	0.428	0.438	0.447	0.456	0.465
73	0.357	0.365	0.373	0.382	0.391	0.401	0.41	0.42	0.429	0.438	0.447
74	0.341	0.348	0.357	0.365	0.374	0.383	0.393	0.402	0.412	0.421	0.43
75	0.325	0.333	0.341	0.349	0.358	0.367	0.376	0.386	0.395	0.405	0.414
76	0.303	0.311	0.318	0.326	0.334	0.343	0.352	0.361	0.371	0.38	0.39
77	0.283	0.29	0.297	0.304	0.312	0.32	0.329	0.338	0.348	0.357	0.366
78	0.264	0.27	0.277	0.284	0.291	0.299	0.308	0.317	0.326	0.335	0.345
79	0.246	0.252	0.258	0.265	0.272	0.28	0.288	0.297	0.306	0.315	0.324
80	0.229	0.235	0.241	0.248	0.254	0.262	0.27	0.278	0.287	0.296	0.305
∞	0	0	0	0	0	0	0	0	0	0	0

Table A.29: Estimates of probabilities of survival, l_x, for females in presence of AIDS in Zimbabwe for the period 1980-1989. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	1	1	1	1	1	1	1	1	1	1
1	0.925	0.93	0.935	0.94	0.945	0.948	0.951	0.954	0.956	0.958
2	0.915	0.921	0.926	0.931	0.935	0.939	0.942	0.944	0.947	0.948
3	0.906	0.912	0.917	0.921	0.925	0.929	0.932	0.935	0.937	0.939
4	0.897	0.902	0.907	0.912	0.916	0.92	0.923	0.925	0.927	0.929
5	0.888	0.893	0.898	0.903	0.907	0.91	0.913	0.916	0.918	0.92
6	0.885	0.891	0.896	0.9	0.905	0.908	0.911	0.914	0.916	0.918
7	0.883	0.888	0.893	0.898	0.902	0.906	0.909	0.912	0.915	0.917
8	0.88	0.886	0.891	0.896	0.9	0.904	0.907	0.91	0.913	0.915
9	0.878	0.884	0.889	0.894	0.898	0.902	0.905	0.908	0.911	0.913
10	0.875	0.881	0.887	0.891	0.896	0.9	0.903	0.907	0.909	0.912
11	0.873	0.879	0.885	0.89	0.894	0.898	0.902	0.905	0.908	0.911
12	0.872	0.877	0.883	0.888	0.892	0.897	0.9	0.904	0.907	0.909
13	0.87	0.876	0.881	0.886	0.891	0.895	0.899	0.902	0.905	0.908
14	0.868	0.874	0.879	0.884	0.889	0.893	0.897	0.901	0.904	0.907
15	0.866	0.872	0.877	0.883	0.887	0.892	0.895	0.899	0.902	0.905
16	0.864	0.87	0.876	0.881	0.885	0.89	0.893	0.897	0.9	0.903
17	0.862	0.868	0.874	0.879	0.883	0.888	0.892	0.895	0.898	0.901
18	0.861	0.866	0.872	0.877	0.882	0.886	0.89	0.893	0.896	0.899
19	0.859	0.865	0.87	0.875	0.88	0.884	0.888	0.891	0.895	0.897
20	0.857	0.863	0.868	0.873	0.878	0.882	0.886	0.889	0.893	0.895
21	0.854	0.86	0.866	0.871	0.875	0.88	0.883	0.887	0.89	0.893
22	0.852	0.858	0.863	0.868	0.873	0.877	0.881	0.885	0.888	0.891
23	0.849	0.855	0.861	0.866	0.871	0.875	0.879	0.882	0.886	0.888
24	0.846	0.852	0.858	0.863	0.868	0.872	0.876	0.88	0.883	0.886
25	0.844	0.85	0.856	0.861	0.866	0.87	0.874	0.878	0.881	0.883
26	0.841	0.847	0.853	0.858	0.863	0.867	0.871	0.875	0.878	0.881
27	0.838	0.844	0.85	0.855	0.86	0.864	0.868	0.872	0.876	0.878
28	0.835	0.841	0.847	0.852	0.857	0.861	0.865	0.869	0.873	0.876
29	0.833	0.839	0.844	0.849	0.854	0.858	0.862	0.866	0.87	0.873
30	0.83	0.836	0.841	0.846	0.851	0.855	0.86	0.864	0.868	0.871
31	0.827	0.833	0.838	0.843	0.848	0.852	0.856	0.861	0.865	0.868
32	0.823	0.829	0.835	0.84	0.845	0.849	0.853	0.858	0.862	0.865
33	0.82	0.826	0.832	0.837	0.841	0.846	0.85	0.855	0.859	0.863

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AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
34	0.817	0.823	0.828	0.834	0.838	0.843	0.847	0.852	0.857	0.86
35	0.814	0.82	0.825	0.83	0.835	0.84	0.844	0.849	0.854	0.857
36	0.81	0.816	0.822	0.826	0.831	0.836	0.84	0.845	0.851	0.854
37	0.807	0.813	0.818	0.823	0.827	0.832	0.837	0.842	0.847	0.851
38	0.804	0.809	0.814	0.819	0.823	0.828	0.833	0.838	0.844	0.848
39	0.801	0.806	0.81	0.815	0.819	0.824	0.829	0.835	0.841	0.845
40	0.797	0.802	0.807	0.811	0.815	0.82	0.825	0.831	0.838	0.843
41	0.793	0.798	0.802	0.807	0.811	0.816	0.821	0.827	0.834	0.839
42	0.788	0.793	0.798	0.802	0.807	0.812	0.817	0.823	0.83	0.835
43	0.784	0.789	0.794	0.798	0.803	0.808	0.813	0.819	0.826	0.831
44	0.779	0.785	0.79	0.794	0.799	0.804	0.809	0.815	0.822	0.827
45	0.775	0.78	0.785	0.79	0.795	0.799	0.805	0.811	0.818	0.823
46	0.77	0.775	0.78	0.785	0.789	0.794	0.8	0.806	0.813	0.819
47	0.765	0.77	0.775	0.779	0.784	0.789	0.795	0.802	0.809	0.815
48	0.759	0.765	0.77	0.774	0.779	0.784	0.79	0.797	0.804	0.81
49	0.754	0.76	0.765	0.769	0.774	0.779	0.785	0.792	0.8	0.806
50	0.749	0.755	0.759	0.764	0.769	0.774	0.78	0.787	0.795	0.802
51	0.743	0.748	0.753	0.757	0.762	0.768	0.774	0.781	0.789	0.796
52	0.736	0.741	0.746	0.751	0.756	0.761	0.768	0.775	0.783	0.79
53	0.729	0.735	0.74	0.745	0.749	0.755	0.761	0.769	0.777	0.784
54	0.723	0.728	0.733	0.738	0.743	0.749	0.755	0.763	0.771	0.778
55	0.716	0.722	0.727	0.732	0.737	0.742	0.749	0.756	0.765	0.772
56	0.707	0.713	0.718	0.723	0.728	0.734	0.741	0.748	0.757	0.764
57	0.699	0.704	0.71	0.715	0.72	0.726	0.732	0.74	0.749	0.756
58	0.69	0.696	0.701	0.706	0.712	0.717	0.724	0.732	0.741	0.748
59	0.681	0.687	0.693	0.698	0.703	0.709	0.716	0.724	0.733	0.74
60	0.673	0.679	0.684	0.69	0.695	0.701	0.708	0.716	0.725	0.733
61	0.66	0.666	0.672	0.677	0.682	0.688	0.696	0.704	0.713	0.721
62	0.648	0.654	0.659	0.665	0.67	0.676	0.683	0.692	0.702	0.71
63	0.637	0.642	0.647	0.652	0.658	0.664	0.671	0.68	0.69	0.699
64	0.625	0.63	0.635	0.64	0.645	0.652	0.659	0.669	0.679	0.688
65	0.614	0.619	0.624	0.628	0.634	0.64	0.648	0.657	0.668	0.677
66	0.595	0.6	0.606	0.611	0.616	0.623	0.63	0.639	0.65	0.659
67	0.576	0.582	0.588	0.594	0.599	0.606	0.613	0.622	0.632	0.641
68	0.558	0.565	0.571	0.577	0.583	0.589	0.597	0.605	0.615	0.624
69	0.541	0.548	0.555	0.561	0.567	0.573	0.58	0.589	0.598	0.608

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AGE	YEAR									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
70	0.524	0.532	0.539	0.545	0.551	0.558	0.565	0.573	0.582	0.591
71	0.5	0.507	0.514	0.519	0.525	0.532	0.539	0.548	0.558	0.568
72	0.477	0.484	0.49	0.495	0.5	0.507	0.515	0.524	0.535	0.545
73	0.456	0.461	0.467	0.471	0.477	0.483	0.491	0.501	0.512	0.523
74	0.435	0.44	0.445	0.449	0.454	0.461	0.469	0.479	0.491	0.502
75	0.416	0.42	0.424	0.428	0.433	0.439	0.448	0.458	0.47	0.482
76	0.381	0.385	0.389	0.393	0.398	0.405	0.413	0.423	0.435	0.445
77	0.349	0.353	0.357	0.361	0.366	0.373	0.381	0.391	0.401	0.412
78	0.319	0.324	0.328	0.332	0.337	0.343	0.351	0.361	0.371	0.381
79	0.292	0.297	0.301	0.305	0.31	0.316	0.324	0.333	0.343	0.352
80	0.268	0.272	0.276	0.28	0.285	0.291	0.299	0.307	0.317	0.325
∞	0	0	0	0	0	0	0	0	0	0

Table A.30: Estimates of probabilities of survival, l_x, for females in presence of AIDS in Zimbabwe for the period 1990-1999. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
0	1	1	1	1	1	1	1	1	1	1
1	0.959	0.959	0.958	0.956	0.952	0.948	0.944	0.941	0.938	0.936
2	0.949	0.949	0.948	0.946	0.943	0.939	0.935	0.931	0.928	0.927
3	0.939	0.94	0.939	0.936	0.933	0.929	0.925	0.922	0.919	0.917
4	0.93	0.93	0.929	0.927	0.924	0.92	0.916	0.912	0.91	0.908
5	0.921	0.921	0.92	0.918	0.914	0.91	0.907	0.903	0.9	0.899
6	0.919	0.919	0.919	0.917	0.913	0.909	0.905	0.902	0.899	0.897
7	0.918	0.918	0.918	0.916	0.912	0.908	0.904	0.9	0.897	0.895
8	0.916	0.917	0.916	0.914	0.911	0.907	0.903	0.899	0.896	0.894
9	0.915	0.916	0.915	0.913	0.91	0.906	0.902	0.898	0.894	0.892
10	0.914	0.915	0.914	0.912	0.909	0.905	0.9	0.896	0.893	0.89
11	0.913	0.914	0.913	0.912	0.908	0.904	0.9	0.895	0.892	0.889
12	0.911	0.912	0.912	0.911	0.907	0.903	0.899	0.894	0.891	0.888
13	0.91	0.911	0.911	0.91	0.907	0.902	0.898	0.894	0.89	0.887
14	0.909	0.91	0.91	0.909	0.906	0.902	0.897	0.893	0.889	0.886
15	0.908	0.909	0.909	0.908	0.905	0.901	0.896	0.892	0.888	0.885
16	0.906	0.907	0.907	0.906	0.903	0.899	0.894	0.89	0.886	0.883
17	0.904	0.905	0.905	0.904	0.9	0.896	0.892	0.887	0.883	0.88
18	0.902	0.903	0.903	0.901	0.898	0.894	0.89	0.885	0.881	0.878
19	0.9	0.901	0.901	0.899	0.896	0.892	0.887	0.883	0.879	0.876
20	0.898	0.899	0.899	0.897	0.894	0.89	0.885	0.88	0.876	0.873
21	0.895	0.896	0.895	0.892	0.887	0.882	0.876	0.87	0.866	0.863
22	0.892	0.893	0.891	0.887	0.881	0.874	0.867	0.86	0.855	0.852
23	0.89	0.889	0.887	0.882	0.875	0.866	0.858	0.85	0.845	0.842
24	0.887	0.886	0.883	0.877	0.868	0.858	0.849	0.84	0.835	0.831
25	0.884	0.883	0.879	0.872	0.862	0.851	0.84	0.831	0.824	0.821
26	0.882	0.88	0.874	0.865	0.852	0.837	0.822	0.81	0.8	0.794
27	0.879	0.876	0.87	0.858	0.841	0.823	0.805	0.789	0.776	0.767
28	0.876	0.873	0.865	0.851	0.831	0.81	0.788	0.769	0.753	0.741
29	0.874	0.87	0.86	0.844	0.821	0.797	0.772	0.749	0.73	0.717
30	0.871	0.866	0.855	0.837	0.812	0.784	0.755	0.73	0.708	0.693
31	0.868	0.863	0.85	0.83	0.802	0.771	0.74	0.71	0.685	0.665
32	0.865	0.859	0.846	0.823	0.793	0.759	0.725	0.692	0.662	0.637
33	0.862	0.856	0.841	0.817	0.784	0.748	0.71	0.673	0.64	0.612

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AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
34	0.859	0.852	0.836	0.81	0.776	0.736	0.695	0.655	0.619	0.587
35	0.857	0.849	0.832	0.804	0.767	0.725	0.681	0.638	0.598	0.563
36	0.854	0.845	0.827	0.798	0.759	0.715	0.668	0.623	0.581	0.543
37	0.851	0.842	0.823	0.792	0.751	0.705	0.656	0.609	0.564	0.524
38	0.848	0.838	0.819	0.787	0.744	0.695	0.645	0.595	0.548	0.505
39	0.845	0.835	0.814	0.781	0.736	0.686	0.633	0.581	0.532	0.487
40	0.842	0.832	0.81	0.775	0.729	0.677	0.622	0.568	0.516	0.47
41	0.838	0.828	0.806	0.77	0.723	0.669	0.613	0.557	0.504	0.456
42	0.834	0.824	0.801	0.765	0.716	0.662	0.604	0.547	0.493	0.443
43	0.83	0.82	0.797	0.759	0.71	0.654	0.595	0.537	0.481	0.431
44	0.826	0.816	0.792	0.754	0.704	0.647	0.587	0.527	0.47	0.418
45	0.823	0.812	0.788	0.749	0.698	0.64	0.578	0.518	0.459	0.406
46	0.818	0.807	0.783	0.744	0.692	0.633	0.571	0.51	0.451	0.397
47	0.814	0.803	0.778	0.739	0.686	0.626	0.564	0.502	0.443	0.389
48	0.81	0.798	0.774	0.733	0.68	0.62	0.557	0.494	0.434	0.38
49	0.805	0.794	0.769	0.728	0.675	0.613	0.55	0.487	0.426	0.372
50	0.801	0.79	0.764	0.723	0.669	0.607	0.543	0.479	0.419	0.364
51	0.795	0.784	0.759	0.718	0.663	0.602	0.537	0.473	0.412	0.357
52	0.789	0.778	0.753	0.712	0.658	0.596	0.531	0.467	0.406	0.35
53	0.784	0.773	0.748	0.707	0.653	0.591	0.526	0.461	0.399	0.343
54	0.778	0.767	0.742	0.701	0.647	0.585	0.52	0.455	0.393	0.337
55	0.772	0.761	0.737	0.696	0.642	0.58	0.515	0.449	0.387	0.33
56	0.764	0.754	0.729	0.689	0.635	0.574	0.508	0.444	0.381	0.325
57	0.757	0.747	0.722	0.682	0.629	0.567	0.502	0.438	0.376	0.32
58	0.749	0.739	0.715	0.675	0.622	0.561	0.496	0.432	0.371	0.315
59	0.741	0.732	0.708	0.668	0.616	0.555	0.491	0.427	0.365	0.31
60	0.734	0.725	0.701	0.662	0.609	0.549	0.485	0.421	0.36	0.306
61	0.723	0.714	0.691	0.652	0.6	0.54	0.477	0.414	0.354	0.3
62	0.712	0.703	0.681	0.643	0.591	0.532	0.47	0.407	0.348	0.294
63	0.701	0.693	0.671	0.633	0.583	0.524	0.462	0.401	0.342	0.289
64	0.691	0.683	0.661	0.624	0.574	0.516	0.455	0.394	0.336	0.283
65	0.68	0.673	0.651	0.615	0.565	0.508	0.448	0.388	0.33	0.278
66	0.662	0.656	0.635	0.6	0.552	0.496	0.437	0.378	0.322	0.271
67	0.645	0.639	0.62	0.586	0.539	0.485	0.427	0.369	0.314	0.264
68	0.628	0.623	0.605	0.572	0.526	0.473	0.417	0.36	0.306	0.257
69	0.612	0.607	0.59	0.558	0.514	0.462	0.407	0.351	0.298	0.25

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AGE	YEAR									
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
70	0.596	0.592	0.575	0.545	0.502	0.451	0.397	0.343	0.291	0.244
71	0.573	0.569	0.553	0.524	0.482	0.433	0.381	0.329	0.279	0.234
72	0.55	0.547	0.532	0.503	0.463	0.416	0.366	0.316	0.268	0.225
73	0.529	0.526	0.512	0.484	0.445	0.399	0.351	0.303	0.257	0.216
74	0.508	0.506	0.492	0.465	0.427	0.384	0.337	0.291	0.247	0.207
75	0.488	0.486	0.473	0.447	0.411	0.368	0.324	0.279	0.237	0.199
76	0.452	0.45	0.439	0.415	0.382	0.343	0.302	0.261	0.221	0.186
77	0.418	0.417	0.407	0.385	0.355	0.32	0.282	0.244	0.207	0.174
78	0.386	0.386	0.377	0.358	0.331	0.298	0.263	0.228	0.193	0.162
79	0.357	0.357	0.349	0.332	0.308	0.278	0.245	0.213	0.181	0.151
80	0.331	0.331	0.324	0.309	0.286	0.259	0.229	0.199	0.169	0.141
∞	0	0	0	0	0	0	0	0	0	0

Table A.31: Estimates of probabilities of survival, l_x, for females in presence of AIDS in Zimbabwe for the period 2000-2009. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0	1	1	1	1	1	1	1	1	1	1
1	0.936	0.936	0.937	0.938	0.94	0.937	0.939	0.942	0.945	0.948
2	0.927	0.927	0.927	0.929	0.93	0.929	0.931	0.934	0.936	0.94
3	0.917	0.917	0.918	0.919	0.92	0.92	0.922	0.925	0.928	0.931
4	0.908	0.908	0.908	0.91	0.911	0.912	0.914	0.917	0.919	0.923
5	0.898	0.898	0.899	0.9	0.902	0.903	0.906	0.908	0.911	0.914
6	0.896	0.896	0.897	0.898	0.899	0.901	0.903	0.906	0.908	0.912
7	0.894	0.894	0.895	0.895	0.897	0.898	0.9	0.903	0.906	0.909
8	0.893	0.892	0.892	0.893	0.894	0.896	0.898	0.9	0.903	0.907
9	0.891	0.89	0.89	0.89	0.891	0.893	0.895	0.898	0.901	0.904
10	0.889	0.888	0.888	0.888	0.889	0.89	0.893	0.895	0.898	0.902
11	0.887	0.886	0.886	0.886	0.887	0.888	0.89	0.892	0.895	0.898
12	0.886	0.885	0.884	0.884	0.885	0.885	0.887	0.889	0.892	0.895
13	0.885	0.884	0.883	0.882	0.882	0.883	0.884	0.886	0.889	0.892
14	0.884	0.882	0.881	0.88	0.88	0.88	0.881	0.883	0.885	0.888
15	0.882	0.881	0.879	0.878	0.878	0.878	0.879	0.88	0.882	0.885
16	0.88	0.878	0.877	0.876	0.875	0.875	0.876	0.877	0.879	0.882
17	0.878	0.876	0.874	0.873	0.873	0.873	0.873	0.874	0.877	0.879
18	0.875	0.874	0.872	0.871	0.87	0.87	0.87	0.872	0.874	0.876
19	0.873	0.871	0.87	0.868	0.868	0.867	0.868	0.869	0.871	0.874
20	0.871	0.869	0.867	0.866	0.865	0.865	0.865	0.866	0.868	0.871
21	0.86	0.859	0.858	0.857	0.857	0.857	0.858	0.859	0.861	0.864
22	0.85	0.849	0.848	0.848	0.848	0.849	0.85	0.852	0.854	0.857
23	0.84	0.839	0.839	0.84	0.84	0.841	0.843	0.845	0.847	0.85
24	0.83	0.829	0.83	0.831	0.832	0.834	0.836	0.838	0.84	0.843
25	0.82	0.82	0.821	0.822	0.824	0.826	0.828	0.831	0.833	0.836
26	0.79	0.789	0.79	0.793	0.797	0.801	0.806	0.81	0.814	0.818
27	0.762	0.76	0.761	0.765	0.77	0.777	0.783	0.79	0.795	0.8
28	0.734	0.732	0.733	0.737	0.744	0.753	0.762	0.77	0.777	0.782
29	0.708	0.704	0.705	0.711	0.719	0.73	0.741	0.751	0.759	0.765
30	0.683	0.678	0.679	0.685	0.695	0.708	0.721	0.732	0.742	0.748
31	0.65	0.641	0.638	0.642	0.652	0.666	0.682	0.697	0.709	0.718
32	0.618	0.606	0.6	0.602	0.611	0.626	0.644	0.662	0.677	0.688
33	0.589	0.572	0.563	0.564	0.573	0.589	0.609	0.63	0.647	0.66

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AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
34	0.56	0.541	0.529	0.528	0.537	0.554	0.576	0.599	0.619	0.633
35	0.533	0.511	0.497	0.495	0.504	0.521	0.545	0.57	0.591	0.607
36	0.511	0.486	0.47	0.466	0.473	0.49	0.513	0.538	0.56	0.577
37	0.489	0.462	0.445	0.439	0.444	0.46	0.482	0.507	0.53	0.548
38	0.469	0.44	0.42	0.413	0.417	0.432	0.454	0.478	0.501	0.52
39	0.449	0.418	0.397	0.389	0.392	0.406	0.427	0.451	0.474	0.494
40	0.43	0.398	0.376	0.366	0.368	0.381	0.401	0.426	0.449	0.469
41	0.415	0.382	0.359	0.349	0.35	0.362	0.382	0.406	0.429	0.449
42	0.401	0.367	0.343	0.332	0.333	0.345	0.364	0.388	0.41	0.43
43	0.387	0.353	0.328	0.317	0.317	0.328	0.347	0.37	0.392	0.412
44	0.374	0.339	0.314	0.302	0.302	0.312	0.33	0.353	0.375	0.395
45	0.361	0.325	0.3	0.287	0.287	0.297	0.315	0.337	0.359	0.378
46	0.352	0.316	0.29	0.277	0.277	0.286	0.303	0.325	0.347	0.366
47	0.343	0.306	0.281	0.268	0.267	0.276	0.292	0.313	0.335	0.354
48	0.334	0.297	0.272	0.258	0.257	0.266	0.282	0.302	0.324	0.343
49	0.325	0.289	0.263	0.249	0.248	0.256	0.272	0.292	0.313	0.332
50	0.317	0.28	0.254	0.241	0.239	0.246	0.262	0.282	0.302	0.321
51	0.31	0.273	0.248	0.234	0.232	0.24	0.255	0.274	0.295	0.314
52	0.303	0.267	0.241	0.228	0.226	0.234	0.248	0.267	0.287	0.306
53	0.296	0.26	0.235	0.222	0.22	0.227	0.242	0.26	0.28	0.298
54	0.29	0.254	0.229	0.216	0.214	0.221	0.235	0.254	0.273	0.291
55	0.283	0.247	0.223	0.21	0.208	0.215	0.229	0.247	0.266	0.284
56	0.279	0.243	0.218	0.205	0.204	0.21	0.224	0.242	0.26	0.278
57	0.274	0.238	0.213	0.201	0.199	0.205	0.219	0.236	0.255	0.273
58	0.269	0.234	0.209	0.196	0.194	0.2	0.214	0.231	0.249	0.267
59	0.265	0.229	0.205	0.192	0.189	0.196	0.209	0.226	0.244	0.262
60	0.26	0.225	0.2	0.187	0.185	0.191	0.204	0.221	0.239	0.257
61	0.255	0.22	0.196	0.184	0.181	0.187	0.199	0.216	0.234	0.251
62	0.25	0.216	0.192	0.18	0.177	0.183	0.195	0.211	0.229	0.245
63	0.245	0.211	0.188	0.176	0.173	0.179	0.191	0.207	0.224	0.24
64	0.24	0.207	0.184	0.172	0.17	0.175	0.187	0.202	0.219	0.235
65	0.235	0.203	0.18	0.168	0.166	0.171	0.183	0.198	0.214	0.23
66	0.229	0.197	0.175	0.164	0.161	0.167	0.178	0.192	0.208	0.223
67	0.223	0.192	0.17	0.159	0.157	0.162	0.173	0.187	0.202	0.218
68	0.217	0.186	0.165	0.154	0.152	0.157	0.168	0.182	0.197	0.212
69	0.211	0.181	0.161	0.15	0.148	0.153	0.163	0.177	0.192	0.206

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AGE	YEAR									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
70	0.206	0.176	0.156	0.146	0.144	0.148	0.158	0.172	0.186	0.201
71	0.197	0.169	0.15	0.14	0.138	0.142	0.152	0.165	0.179	0.192
72	0.189	0.162	0.144	0.134	0.132	0.136	0.145	0.158	0.171	0.184
73	0.182	0.156	0.138	0.128	0.126	0.13	0.139	0.151	0.164	0.177
74	0.174	0.149	0.132	0.123	0.121	0.125	0.133	0.145	0.157	0.169
75	0.167	0.143	0.127	0.118	0.116	0.119	0.128	0.139	0.15	0.162
76	0.156	0.134	0.118	0.11	0.108	0.111	0.119	0.129	0.14	0.151
77	0.146	0.125	0.11	0.102	0.101	0.104	0.111	0.121	0.131	0.141
78	0.136	0.116	0.103	0.096	0.094	0.097	0.103	0.112	0.122	0.132
79	0.127	0.109	0.096	0.089	0.088	0.09	0.096	0.105	0.114	0.123
80	0.119	0.101	0.089	0.083	0.082	0.084	0.09	0.098	0.106	0.115
∞	0	0	0	0	0	0	0	0	0	0

Table A.32: Projection of probabilities of survival, l_x, for females in presence of AIDS in Zimbabwe for the period 2010-2019. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
0	1	1	1	1	1	1	1	1	1	1
1	0.945	0.948	0.951	0.955	0.958	0.954	0.957	0.96	0.962	0.964
2	0.938	0.941	0.944	0.948	0.951	0.949	0.952	0.954	0.957	0.959
3	0.931	0.934	0.937	0.941	0.944	0.944	0.946	0.949	0.952	0.954
4	0.924	0.927	0.931	0.934	0.937	0.938	0.941	0.944	0.946	0.949
5	0.917	0.92	0.924	0.927	0.93	0.933	0.936	0.939	0.941	0.943
6	0.915	0.918	0.921	0.925	0.928	0.931	0.934	0.937	0.94	0.942
7	0.912	0.916	0.919	0.923	0.926	0.929	0.933	0.935	0.938	0.94
8	0.91	0.913	0.917	0.921	0.924	0.928	0.931	0.934	0.937	0.939
9	0.908	0.911	0.915	0.919	0.922	0.926	0.929	0.932	0.935	0.938
10	0.905	0.909	0.913	0.916	0.92	0.924	0.927	0.93	0.933	0.936
11	0.902	0.906	0.909	0.913	0.917	0.921	0.924	0.928	0.931	0.934
12	0.898	0.902	0.906	0.91	0.914	0.918	0.922	0.925	0.928	0.931
13	0.895	0.899	0.903	0.907	0.911	0.915	0.919	0.923	0.926	0.929
14	0.892	0.896	0.9	0.904	0.908	0.912	0.916	0.92	0.923	0.927
15	0.889	0.892	0.896	0.901	0.905	0.909	0.913	0.917	0.921	0.924
16	0.886	0.889	0.893	0.898	0.902	0.906	0.91	0.914	0.918	0.921
17	0.883	0.886	0.89	0.895	0.899	0.903	0.907	0.911	0.915	0.918
18	0.88	0.883	0.887	0.891	0.896	0.9	0.904	0.908	0.912	0.915
19	0.877	0.88	0.884	0.888	0.893	0.897	0.901	0.905	0.909	0.912
20	0.874	0.877	0.881	0.885	0.889	0.894	0.898	0.902	0.906	0.909
21	0.867	0.87	0.874	0.878	0.883	0.887	0.891	0.896	0.9	0.903
22	0.86	0.863	0.867	0.872	0.876	0.88	0.885	0.889	0.894	0.897
23	0.853	0.857	0.86	0.865	0.869	0.874	0.879	0.883	0.888	0.892
24	0.846	0.85	0.854	0.858	0.863	0.867	0.872	0.877	0.882	0.886
25	0.84	0.843	0.847	0.851	0.856	0.861	0.866	0.871	0.876	0.88
26	0.821	0.825	0.829	0.833	0.838	0.844	0.849	0.855	0.86	0.865
27	0.804	0.807	0.811	0.816	0.821	0.827	0.833	0.839	0.845	0.85
28	0.786	0.79	0.794	0.799	0.804	0.811	0.817	0.823	0.83	0.835
29	0.77	0.773	0.777	0.782	0.788	0.794	0.801	0.808	0.815	0.821
30	0.753	0.757	0.761	0.766	0.772	0.779	0.786	0.793	0.8	0.807
31	0.724	0.729	0.734	0.74	0.746	0.753	0.761	0.769	0.776	0.783
32	0.696	0.703	0.708	0.714	0.721	0.729	0.737	0.745	0.753	0.76
33	0.67	0.677	0.683	0.69	0.697	0.705	0.714	0.722	0.73	0.738

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AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
34	0.644	0.652	0.659	0.666	0.674	0.682	0.691	0.7	0.708	0.716
35	0.619	0.628	0.636	0.643	0.652	0.66	0.669	0.678	0.687	0.696
36	0.59	0.601	0.61	0.618	0.627	0.636	0.646	0.655	0.664	0.673
37	0.562	0.574	0.584	0.594	0.604	0.614	0.623	0.632	0.642	0.651
38	0.536	0.549	0.56	0.571	0.581	0.591	0.601	0.611	0.621	0.63
39	0.51	0.525	0.537	0.549	0.56	0.57	0.58	0.59	0.6	0.61
40	0.486	0.501	0.515	0.527	0.539	0.549	0.56	0.57	0.58	0.59
41	0.467	0.482	0.496	0.508	0.52	0.531	0.541	0.551	0.562	0.573
42	0.448	0.464	0.478	0.49	0.502	0.513	0.523	0.534	0.545	0.556
43	0.43	0.446	0.46	0.473	0.484	0.495	0.506	0.517	0.528	0.539
44	0.413	0.429	0.443	0.456	0.467	0.478	0.489	0.5	0.511	0.523
45	0.396	0.412	0.427	0.439	0.451	0.462	0.473	0.484	0.495	0.507
46	0.384	0.4	0.415	0.427	0.439	0.45	0.46	0.471	0.483	0.494
47	0.372	0.389	0.403	0.416	0.427	0.438	0.448	0.459	0.47	0.481
48	0.361	0.377	0.392	0.404	0.416	0.426	0.437	0.447	0.458	0.469
49	0.35	0.366	0.381	0.394	0.405	0.415	0.425	0.435	0.446	0.457
50	0.339	0.356	0.37	0.383	0.394	0.404	0.414	0.424	0.434	0.445
51	0.331	0.347	0.362	0.375	0.386	0.396	0.406	0.416	0.426	0.436
52	0.323	0.339	0.354	0.367	0.378	0.388	0.398	0.407	0.417	0.428
53	0.316	0.332	0.346	0.359	0.37	0.38	0.39	0.399	0.409	0.419
54	0.308	0.324	0.339	0.351	0.363	0.373	0.382	0.391	0.401	0.411
55	0.301	0.317	0.331	0.344	0.355	0.365	0.374	0.384	0.393	0.403
56	0.295	0.311	0.325	0.338	0.349	0.359	0.368	0.377	0.386	0.396
57	0.289	0.305	0.319	0.332	0.343	0.352	0.362	0.37	0.38	0.39
58	0.284	0.299	0.314	0.326	0.337	0.346	0.355	0.364	0.373	0.383
59	0.278	0.294	0.308	0.32	0.331	0.34	0.349	0.358	0.367	0.377
60	0.273	0.289	0.302	0.314	0.325	0.334	0.343	0.352	0.361	0.37
61	0.267	0.283	0.296	0.308	0.319	0.328	0.337	0.345	0.354	0.364
62	0.261	0.277	0.29	0.303	0.313	0.322	0.331	0.339	0.348	0.357
63	0.256	0.271	0.285	0.297	0.307	0.317	0.325	0.333	0.342	0.351
64	0.25	0.265	0.279	0.291	0.302	0.311	0.319	0.327	0.336	0.345
65	0.245	0.26	0.273	0.286	0.296	0.305	0.314	0.321	0.33	0.338
66	0.238	0.253	0.266	0.278	0.288	0.297	0.305	0.313	0.322	0.33
67	0.232	0.246	0.259	0.27	0.28	0.289	0.297	0.305	0.314	0.322
68	0.226	0.24	0.252	0.263	0.273	0.281	0.289	0.298	0.306	0.315
69	0.22	0.233	0.246	0.256	0.265	0.274	0.282	0.29	0.299	0.307

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AGE	YEAR									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
70	0.214	0.227	0.239	0.249	0.258	0.266	0.274	0.283	0.291	0.3
71	0.206	0.218	0.23	0.24	0.248	0.256	0.264	0.272	0.28	0.288
72	0.197	0.209	0.221	0.23	0.239	0.247	0.254	0.261	0.269	0.277
73	0.189	0.201	0.212	0.221	0.23	0.237	0.244	0.251	0.258	0.265
74	0.181	0.193	0.203	0.213	0.221	0.228	0.235	0.241	0.248	0.255
75	0.174	0.185	0.195	0.205	0.213	0.22	0.226	0.232	0.238	0.245
76	0.162	0.173	0.183	0.191	0.199	0.206	0.212	0.217	0.223	0.229
77	0.152	0.162	0.171	0.179	0.186	0.192	0.198	0.203	0.209	0.215
78	0.142	0.151	0.16	0.168	0.174	0.18	0.185	0.19	0.196	0.202
79	0.132	0.141	0.15	0.157	0.163	0.168	0.173	0.178	0.183	0.189
80	0.124	0.132	0.14	0.147	0.153	0.158	0.162	0.167	0.172	0.177
∞	0	0	0	0	0	0	0	0	0	0

Table A.33: Projection of probabilities of survival, l_x, for females in presence of AIDS in Zimbabwe for the period 2020-2029. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
0	1	1	1	1	1	1	1	1	1	1
1	0.962	0.964	0.965	0.967	0.968	0.967	0.968	0.969	0.971	0.972
2	0.958	0.96	0.961	0.963	0.964	0.963	0.965	0.966	0.967	0.968
3	0.954	0.955	0.957	0.959	0.96	0.96	0.961	0.962	0.964	0.965
4	0.95	0.951	0.953	0.954	0.956	0.957	0.958	0.959	0.96	0.961
5	0.945	0.947	0.949	0.95	0.952	0.953	0.954	0.956	0.957	0.958
6	0.944	0.946	0.948	0.949	0.951	0.952	0.953	0.955	0.956	0.957
7	0.943	0.945	0.946	0.948	0.95	0.951	0.952	0.954	0.955	0.956
8	0.941	0.943	0.945	0.947	0.948	0.95	0.951	0.953	0.954	0.955
9	0.94	0.942	0.944	0.946	0.947	0.949	0.95	0.952	0.953	0.954
10	0.938	0.941	0.943	0.944	0.946	0.948	0.949	0.951	0.952	0.953
11	0.936	0.939	0.941	0.943	0.944	0.946	0.948	0.949	0.951	0.952
12	0.934	0.936	0.939	0.941	0.943	0.944	0.946	0.948	0.949	0.951
13	0.932	0.934	0.937	0.939	0.941	0.943	0.945	0.946	0.948	0.949
14	0.93	0.932	0.935	0.937	0.939	0.941	0.943	0.945	0.946	0.948
15	0.927	0.93	0.933	0.935	0.937	0.939	0.941	0.943	0.945	0.946
16	0.924	0.927	0.93	0.932	0.935	0.937	0.939	0.941	0.943	0.944
17	0.921	0.924	0.927	0.93	0.932	0.935	0.937	0.939	0.941	0.942
18	0.919	0.922	0.924	0.927	0.93	0.932	0.934	0.937	0.939	0.94
19	0.916	0.919	0.922	0.925	0.927	0.93	0.932	0.934	0.936	0.938
20	0.913	0.916	0.919	0.922	0.925	0.927	0.93	0.932	0.934	0.936
21	0.907	0.91	0.913	0.916	0.919	0.922	0.925	0.927	0.929	0.932
22	0.901	0.905	0.908	0.911	0.914	0.917	0.92	0.922	0.925	0.927
23	0.895	0.899	0.902	0.905	0.909	0.912	0.914	0.917	0.92	0.922
24	0.89	0.893	0.897	0.9	0.903	0.906	0.909	0.912	0.915	0.918
25	0.884	0.888	0.891	0.895	0.898	0.901	0.904	0.907	0.91	0.913
26	0.869	0.873	0.877	0.881	0.885	0.888	0.891	0.895	0.898	0.901
27	0.855	0.859	0.863	0.867	0.871	0.875	0.879	0.882	0.885	0.889
28	0.841	0.845	0.85	0.854	0.858	0.862	0.866	0.87	0.873	0.877
29	0.827	0.832	0.837	0.841	0.845	0.849	0.853	0.857	0.861	0.865
30	0.813	0.818	0.823	0.828	0.833	0.837	0.841	0.845	0.849	0.853
31	0.79	0.796	0.802	0.807	0.812	0.817	0.822	0.826	0.83	0.834
32	0.767	0.774	0.781	0.787	0.792	0.797	0.803	0.807	0.812	0.816
33	0.746	0.753	0.76	0.767	0.773	0.778	0.784	0.789	0.794	0.799

Continued on next page

AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
34	0.725	0.732	0.74	0.747	0.754	0.76	0.766	0.771	0.776	0.781
35	0.704	0.712	0.721	0.728	0.735	0.742	0.748	0.754	0.759	0.764
36	0.682	0.691	0.699	0.707	0.715	0.722	0.729	0.735	0.741	0.746
37	0.661	0.67	0.679	0.687	0.695	0.703	0.71	0.716	0.723	0.729
38	0.64	0.65	0.659	0.668	0.676	0.684	0.691	0.699	0.705	0.711
39	0.62	0.63	0.64	0.649	0.658	0.666	0.674	0.681	0.688	0.695
40	0.601	0.611	0.621	0.63	0.639	0.648	0.656	0.664	0.671	0.678
41	0.583	0.594	0.604	0.614	0.623	0.632	0.641	0.649	0.657	0.664
42	0.567	0.577	0.588	0.598	0.608	0.617	0.626	0.634	0.642	0.649
43	0.55	0.561	0.572	0.582	0.592	0.602	0.611	0.62	0.628	0.635
44	0.534	0.546	0.557	0.567	0.578	0.587	0.597	0.606	0.614	0.622
45	0.519	0.53	0.542	0.552	0.563	0.573	0.583	0.592	0.6	0.608
46	0.506	0.517	0.529	0.54	0.551	0.561	0.571	0.58	0.589	0.597
47	0.493	0.505	0.516	0.528	0.539	0.549	0.559	0.569	0.578	0.586
48	0.48	0.492	0.504	0.516	0.527	0.538	0.548	0.558	0.567	0.575
49	0.468	0.48	0.492	0.504	0.516	0.527	0.537	0.547	0.556	0.565
50	0.456	0.468	0.48	0.493	0.504	0.516	0.526	0.536	0.545	0.554
51	0.447	0.459	0.471	0.483	0.495	0.506	0.517	0.527	0.536	0.545
52	0.439	0.45	0.462	0.474	0.485	0.497	0.507	0.518	0.527	0.536
53	0.43	0.441	0.453	0.465	0.476	0.487	0.498	0.509	0.518	0.528
54	0.422	0.433	0.444	0.456	0.467	0.478	0.489	0.5	0.51	0.519
55	0.413	0.424	0.436	0.447	0.458	0.469	0.48	0.491	0.501	0.511
56	0.407	0.418	0.429	0.44	0.451	0.462	0.473	0.483	0.493	0.503
57	0.4	0.411	0.422	0.433	0.444	0.455	0.465	0.476	0.486	0.495
58	0.393	0.404	0.415	0.426	0.437	0.447	0.458	0.468	0.478	0.487
59	0.387	0.397	0.408	0.419	0.43	0.44	0.451	0.461	0.471	0.48
60	0.38	0.391	0.402	0.412	0.423	0.433	0.444	0.454	0.463	0.472
61	0.374	0.384	0.395	0.405	0.416	0.426	0.436	0.446	0.456	0.464
62	0.367	0.377	0.388	0.398	0.409	0.419	0.429	0.439	0.448	0.457
63	0.36	0.371	0.381	0.391	0.402	0.412	0.422	0.432	0.441	0.449
64	0.354	0.364	0.374	0.385	0.395	0.405	0.415	0.424	0.433	0.442
65	0.348	0.357	0.368	0.378	0.388	0.398	0.408	0.417	0.426	0.435
66	0.34	0.349	0.359	0.369	0.379	0.389	0.399	0.408	0.417	0.425
67	0.332	0.341	0.351	0.36	0.37	0.38	0.389	0.398	0.407	0.415
68	0.324	0.333	0.343	0.352	0.361	0.371	0.38	0.389	0.398	0.406
69	0.316	0.325	0.335	0.344	0.353	0.362	0.371	0.38	0.389	0.397

Continued on next page

AGE	YEAR									
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
70	0.309	0.318	0.327	0.336	0.345	0.354	0.363	0.371	0.38	0.388
71	0.297	0.306	0.315	0.324	0.332	0.341	0.35	0.358	0.366	0.374
72	0.285	0.294	0.303	0.312	0.321	0.33	0.338	0.346	0.354	0.361
73	0.273	0.282	0.291	0.3	0.309	0.318	0.326	0.334	0.341	0.348
74	0.263	0.271	0.28	0.29	0.299	0.307	0.315	0.322	0.329	0.336
75	0.252	0.261	0.27	0.279	0.288	0.296	0.304	0.311	0.318	0.324
76	0.236	0.245	0.253	0.262	0.271	0.279	0.286	0.293	0.299	0.305
77	0.222	0.23	0.238	0.246	0.255	0.262	0.269	0.276	0.282	0.288
78	0.208	0.216	0.224	0.232	0.239	0.247	0.253	0.26	0.266	0.271
79	0.195	0.202	0.21	0.218	0.225	0.232	0.239	0.245	0.25	0.255
80	0.183	0.19	0.197	0.205	0.212	0.218	0.224	0.23	0.236	0.241
∞	0	0	0	0	0	0	0	0	0	0

Table A.34: Projection of probabilities of survival, l_x, for females in presence of AIDS in Zimbabwe for the period 2030-2039. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
0	1	1	1	1	1	1	1	1	1	1
1	0.971	0.972	0.973	0.974	0.975	0.974	0.975	0.976	0.977	0.977
2	0.968	0.969	0.97	0.971	0.972	0.971	0.972	0.973	0.974	0.975
3	0.965	0.966	0.967	0.968	0.969	0.969	0.97	0.971	0.972	0.973
4	0.962	0.963	0.964	0.965	0.966	0.967	0.967	0.968	0.969	0.97
5	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968
6	0.958	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967
7	0.957	0.958	0.959	0.96	0.962	0.963	0.964	0.965	0.965	0.966
8	0.956	0.957	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966
9	0.955	0.957	0.958	0.959	0.96	0.961	0.962	0.963	0.964	0.965
10	0.954	0.956	0.957	0.958	0.959	0.96	0.961	0.962	0.963	0.964
11	0.953	0.954	0.956	0.957	0.958	0.959	0.96	0.961	0.962	0.963
12	0.952	0.953	0.954	0.956	0.957	0.958	0.959	0.96	0.961	0.962
13	0.951	0.952	0.953	0.954	0.956	0.957	0.958	0.959	0.96	0.961
14	0.949	0.951	0.952	0.953	0.954	0.956	0.957	0.958	0.959	0.96
15	0.948	0.949	0.951	0.952	0.953	0.955	0.956	0.957	0.958	0.959
16	0.946	0.948	0.949	0.95	0.952	0.953	0.954	0.955	0.957	0.958
17	0.944	0.946	0.947	0.949	0.95	0.951	0.953	0.954	0.955	0.956
18	0.942	0.944	0.945	0.947	0.948	0.95	0.951	0.952	0.954	0.955
19	0.94	0.942	0.944	0.945	0.947	0.948	0.95	0.951	0.952	0.954
20	0.938	0.94	0.942	0.944	0.945	0.947	0.948	0.95	0.951	0.952
21	0.934	0.936	0.938	0.939	0.941	0.943	0.944	0.946	0.947	0.949
22	0.929	0.931	0.933	0.935	0.937	0.939	0.941	0.942	0.944	0.945
23	0.925	0.927	0.929	0.931	0.933	0.935	0.937	0.938	0.94	0.942
24	0.92	0.923	0.925	0.927	0.929	0.931	0.933	0.935	0.937	0.938
25	0.916	0.918	0.921	0.923	0.925	0.927	0.929	0.931	0.933	0.935
26	0.904	0.906	0.909	0.912	0.914	0.917	0.919	0.921	0.924	0.926
27	0.892	0.895	0.898	0.901	0.904	0.906	0.909	0.912	0.914	0.916
28	0.88	0.883	0.887	0.89	0.893	0.896	0.899	0.902	0.905	0.907
29	0.868	0.872	0.875	0.879	0.882	0.886	0.889	0.892	0.895	0.898
30	0.857	0.861	0.865	0.868	0.872	0.876	0.879	0.883	0.886	0.889
31	0.839	0.843	0.847	0.851	0.855	0.859	0.863	0.867	0.871	0.874
32	0.821	0.825	0.83	0.834	0.838	0.843	0.847	0.851	0.856	0.86
33	0.803	0.808	0.813	0.817	0.822	0.827	0.831	0.836	0.841	0.845

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AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
34	0.786	0.791	0.796	0.801	0.806	0.811	0.816	0.821	0.826	0.831
35	0.769	0.774	0.78	0.785	0.79	0.795	0.801	0.806	0.812	0.817
36	0.752	0.757	0.762	0.768	0.773	0.779	0.785	0.79	0.796	0.802
37	0.734	0.74	0.746	0.751	0.757	0.763	0.769	0.775	0.781	0.787
38	0.718	0.723	0.729	0.735	0.741	0.747	0.753	0.76	0.766	0.773
39	0.701	0.707	0.713	0.719	0.726	0.732	0.738	0.745	0.752	0.758
40	0.685	0.691	0.698	0.704	0.71	0.717	0.724	0.73	0.737	0.744
41	0.671	0.677	0.684	0.69	0.697	0.704	0.711	0.718	0.725	0.732
42	0.656	0.663	0.67	0.677	0.684	0.691	0.698	0.705	0.712	0.72
43	0.643	0.65	0.657	0.664	0.671	0.678	0.685	0.693	0.7	0.708
44	0.629	0.636	0.643	0.651	0.658	0.665	0.673	0.68	0.688	0.696
45	0.616	0.623	0.631	0.638	0.645	0.653	0.661	0.669	0.676	0.684
46	0.605	0.612	0.62	0.627	0.635	0.643	0.651	0.659	0.667	0.675
47	0.594	0.602	0.609	0.617	0.625	0.633	0.641	0.649	0.657	0.665
48	0.583	0.591	0.599	0.607	0.615	0.622	0.631	0.639	0.647	0.656
49	0.573	0.581	0.589	0.597	0.605	0.613	0.621	0.629	0.638	0.647
50	0.563	0.571	0.579	0.587	0.595	0.603	0.611	0.62	0.629	0.637
51	0.554	0.562	0.57	0.578	0.586	0.595	0.603	0.612	0.62	0.629
52	0.545	0.553	0.562	0.57	0.578	0.586	0.595	0.604	0.612	0.621
53	0.536	0.545	0.553	0.561	0.57	0.578	0.587	0.596	0.605	0.614
54	0.528	0.537	0.545	0.553	0.562	0.57	0.579	0.588	0.597	0.606
55	0.52	0.528	0.537	0.545	0.554	0.562	0.571	0.58	0.589	0.598
56	0.512	0.52	0.529	0.538	0.546	0.555	0.564	0.573	0.582	0.591
57	0.504	0.513	0.521	0.53	0.539	0.548	0.556	0.566	0.575	0.584
58	0.496	0.505	0.514	0.522	0.531	0.54	0.549	0.558	0.568	0.577
59	0.489	0.497	0.506	0.515	0.524	0.533	0.542	0.551	0.561	0.57
60	0.481	0.49	0.499	0.508	0.517	0.526	0.535	0.544	0.554	0.563
61	0.473	0.482	0.491	0.5	0.509	0.518	0.527	0.536	0.545	0.555
62	0.465	0.474	0.483	0.491	0.5	0.509	0.519	0.528	0.538	0.547
63	0.458	0.466	0.475	0.483	0.492	0.501	0.511	0.52	0.53	0.539
64	0.45	0.459	0.467	0.475	0.484	0.493	0.503	0.512	0.522	0.532
65	0.443	0.451	0.459	0.468	0.476	0.485	0.495	0.504	0.514	0.524
66	0.433	0.441	0.449	0.457	0.466	0.475	0.484	0.494	0.503	0.513
67	0.423	0.431	0.439	0.447	0.456	0.464	0.473	0.483	0.492	0.502
68	0.414	0.422	0.429	0.437	0.446	0.454	0.463	0.472	0.481	0.491
69	0.405	0.412	0.42	0.428	0.436	0.444	0.453	0.462	0.471	0.48

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AGE	YEAR									
	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
70	0.396	0.403	0.411	0.418	0.426	0.435	0.443	0.452	0.461	0.47
71	0.382	0.389	0.396	0.404	0.412	0.42	0.428	0.437	0.446	0.455
72	0.368	0.375	0.383	0.39	0.398	0.406	0.414	0.422	0.431	0.44
73	0.355	0.362	0.369	0.377	0.384	0.392	0.4	0.408	0.417	0.425
74	0.343	0.35	0.357	0.364	0.371	0.379	0.387	0.395	0.403	0.411
75	0.331	0.337	0.344	0.351	0.359	0.366	0.374	0.382	0.389	0.398
76	0.311	0.318	0.324	0.331	0.338	0.345	0.353	0.36	0.368	0.376
77	0.293	0.299	0.305	0.312	0.318	0.325	0.333	0.34	0.348	0.355
78	0.276	0.282	0.288	0.294	0.3	0.307	0.314	0.321	0.328	0.336
79	0.26	0.266	0.271	0.277	0.283	0.289	0.296	0.303	0.31	0.318
80	0.245	0.25	0.255	0.261	0.267	0.273	0.279	0.286	0.293	0.3
∞	0	0	0	0	0	0	0	0	0	0

Table A.35: Projection of probabilities of survival, l_x, for females in presence of AIDS in Zimbabwe for the period 2040-2050. Data source: own elaborations on UN World Population Prospects, 2006 Revision.

AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
0	1	1	1	1	1	1	1	1	1	1	1
1	0.977	0.977	0.978	0.979	0.98	0.979	0.98	0.981	0.981	0.982	0.983
2	0.975	0.975	0.976	0.977	0.978	0.977	0.978	0.979	0.98	0.98	0.981
3	0.973	0.973	0.974	0.975	0.976	0.976	0.976	0.977	0.978	0.979	0.979
4	0.971	0.971	0.972	0.973	0.974	0.974	0.975	0.976	0.976	0.977	0.978
5	0.969	0.969	0.97	0.971	0.972	0.972	0.973	0.974	0.975	0.975	0.976
6	0.968	0.969	0.969	0.97	0.971	0.972	0.973	0.973	0.974	0.975	0.976
7	0.967	0.968	0.969	0.97	0.97	0.971	0.972	0.973	0.974	0.974	0.975
8	0.967	0.967	0.968	0.969	0.97	0.971	0.971	0.972	0.973	0.974	0.975
9	0.966	0.967	0.968	0.968	0.969	0.97	0.971	0.972	0.972	0.973	0.974
10	0.965	0.966	0.967	0.968	0.969	0.97	0.97	0.971	0.972	0.973	0.974
11	0.964	0.965	0.966	0.967	0.968	0.969	0.969	0.97	0.971	0.972	0.973
12	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.969	0.97	0.971	0.972
13	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.97	0.97	0.971
14	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.97	0.971
15	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969	0.97
16	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.969
17	0.957	0.959	0.96	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968
18	0.956	0.957	0.958	0.959	0.961	0.962	0.963	0.964	0.965	0.966	0.967
19	0.955	0.956	0.957	0.958	0.959	0.96	0.962	0.963	0.964	0.965	0.966
20	0.953	0.955	0.956	0.957	0.958	0.959	0.96	0.962	0.963	0.964	0.965
21	0.95	0.951	0.953	0.954	0.955	0.956	0.958	0.959	0.96	0.961	0.963
22	0.947	0.948	0.949	0.951	0.952	0.954	0.955	0.956	0.958	0.959	0.961
23	0.943	0.945	0.946	0.948	0.949	0.951	0.952	0.954	0.955	0.957	0.958
24	0.94	0.942	0.943	0.945	0.946	0.948	0.95	0.951	0.953	0.954	0.956
25	0.937	0.938	0.94	0.942	0.944	0.945	0.947	0.949	0.95	0.952	0.954
26	0.928	0.93	0.932	0.934	0.936	0.938	0.94	0.942	0.944	0.946	0.948
27	0.919	0.921	0.924	0.926	0.928	0.93	0.933	0.935	0.937	0.94	0.942
28	0.91	0.913	0.915	0.918	0.92	0.923	0.926	0.928	0.931	0.933	0.936
29	0.901	0.904	0.907	0.91	0.913	0.916	0.919	0.922	0.924	0.927	0.93
30	0.893	0.896	0.899	0.902	0.905	0.909	0.912	0.915	0.918	0.921	0.924
31	0.878	0.882	0.886	0.889	0.893	0.897	0.9	0.904	0.907	0.911	0.915
32	0.864	0.868	0.872	0.876	0.88	0.885	0.889	0.893	0.897	0.901	0.905
33	0.85	0.855	0.859	0.864	0.868	0.873	0.877	0.882	0.886	0.891	0.895

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AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
34	0.836	0.841	0.846	0.851	0.856	0.861	0.866	0.871	0.876	0.881	0.886
35	0.823	0.828	0.833	0.839	0.844	0.85	0.855	0.86	0.866	0.871	0.876
36	0.808	0.814	0.82	0.825	0.831	0.837	0.843	0.849	0.854	0.86	0.866
37	0.793	0.8	0.806	0.812	0.818	0.825	0.831	0.837	0.843	0.849	0.855
38	0.779	0.786	0.792	0.799	0.806	0.813	0.819	0.826	0.832	0.839	0.845
39	0.765	0.772	0.779	0.786	0.793	0.801	0.808	0.815	0.821	0.828	0.835
40	0.751	0.759	0.766	0.774	0.781	0.789	0.796	0.803	0.811	0.818	0.825
41	0.739	0.747	0.754	0.762	0.77	0.778	0.786	0.793	0.801	0.808	0.816
42	0.727	0.735	0.743	0.751	0.759	0.767	0.775	0.783	0.791	0.799	0.807
43	0.716	0.723	0.732	0.74	0.748	0.756	0.765	0.773	0.781	0.79	0.798
44	0.704	0.712	0.72	0.729	0.737	0.746	0.755	0.763	0.772	0.781	0.789
45	0.693	0.701	0.709	0.718	0.727	0.736	0.745	0.754	0.763	0.772	0.781
46	0.683	0.692	0.7	0.709	0.718	0.727	0.736	0.745	0.755	0.764	0.773
47	0.674	0.682	0.691	0.7	0.709	0.718	0.728	0.737	0.746	0.756	0.765
48	0.664	0.673	0.682	0.691	0.701	0.71	0.719	0.729	0.739	0.748	0.758
49	0.655	0.664	0.673	0.683	0.692	0.701	0.711	0.721	0.731	0.741	0.75
50	0.646	0.655	0.665	0.674	0.683	0.693	0.703	0.713	0.723	0.733	0.743
51	0.638	0.648	0.657	0.666	0.676	0.686	0.696	0.706	0.716	0.726	0.736
52	0.631	0.64	0.649	0.659	0.669	0.679	0.689	0.699	0.709	0.719	0.729
53	0.623	0.632	0.642	0.652	0.661	0.671	0.682	0.692	0.702	0.712	0.723
54	0.615	0.625	0.634	0.644	0.654	0.664	0.675	0.685	0.695	0.706	0.716
55	0.608	0.617	0.627	0.637	0.647	0.657	0.668	0.678	0.689	0.699	0.71
56	0.6	0.61	0.62	0.63	0.64	0.65	0.661	0.671	0.682	0.692	0.703
57	0.593	0.603	0.613	0.623	0.633	0.644	0.654	0.665	0.675	0.686	0.696
58	0.586	0.596	0.606	0.616	0.626	0.637	0.647	0.658	0.669	0.679	0.69
59	0.579	0.589	0.599	0.609	0.62	0.63	0.641	0.651	0.662	0.673	0.683
60	0.573	0.582	0.592	0.602	0.613	0.623	0.634	0.645	0.656	0.666	0.677
61	0.565	0.574	0.584	0.595	0.605	0.616	0.626	0.637	0.648	0.658	0.669
62	0.557	0.567	0.577	0.587	0.597	0.608	0.619	0.629	0.64	0.651	0.661
63	0.549	0.559	0.569	0.579	0.59	0.6	0.611	0.622	0.632	0.643	0.653
64	0.541	0.551	0.561	0.572	0.582	0.593	0.604	0.614	0.625	0.635	0.646
65	0.534	0.544	0.554	0.564	0.575	0.585	0.596	0.607	0.617	0.628	0.638
66	0.523	0.533	0.543	0.553	0.564	0.575	0.585	0.596	0.606	0.617	0.627
67	0.512	0.522	0.532	0.543	0.553	0.564	0.575	0.585	0.596	0.606	0.616
68	0.501	0.511	0.521	0.532	0.543	0.554	0.564	0.575	0.585	0.595	0.605
69	0.49	0.5	0.511	0.522	0.533	0.544	0.554	0.565	0.575	0.585	0.595

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AGE	YEAR										
	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
70	0.48	0.49	0.501	0.512	0.523	0.534	0.544	0.554	0.565	0.574	0.584
71	0.464	0.474	0.485	0.495	0.506	0.517	0.527	0.538	0.548	0.558	0.569
72	0.449	0.459	0.469	0.479	0.489	0.5	0.511	0.522	0.532	0.543	0.554
73	0.434	0.444	0.454	0.463	0.474	0.484	0.495	0.506	0.517	0.528	0.539
74	0.42	0.429	0.439	0.448	0.458	0.468	0.479	0.491	0.502	0.513	0.524
75	0.406	0.415	0.424	0.434	0.443	0.453	0.464	0.476	0.487	0.499	0.51
76	0.384	0.393	0.402	0.411	0.42	0.43	0.441	0.452	0.464	0.475	0.486
77	0.364	0.372	0.381	0.39	0.399	0.408	0.419	0.429	0.441	0.452	0.463
78	0.344	0.352	0.361	0.369	0.378	0.387	0.397	0.408	0.419	0.43	0.442
79	0.326	0.334	0.342	0.35	0.358	0.367	0.377	0.388	0.399	0.41	0.421
80	0.308	0.316	0.324	0.332	0.34	0.349	0.358	0.368	0.379	0.39	0.401
∞	0	0	0	0	0	0	0	0	0	0	0

Table A.36: Percentage of people ever married by age and sex for Zimbabwe in 1982. Data source: World Fertility and Marriage Data 2003, based on 1982 Zimbabwean census.

	Percentage Ever Married Zimbabwe 1982	
Age	**WOMEN**	**MEN**
15-19	26	2
20-24	76	30
25-29	91	73
30-34	95	88
35-39	96	92
40-44	97	95
45-49	97	95

Table A.37: Marital status by age and sex for Zimbabwe in 1994. The 'Marriage' category includes both formal and informal unions. Data source: Zimbabwe Demographic and Health Survey 1994.

Marital Status Zimbabwe 1994				
Age	**Never Married**	**Married**	**Widowed**	**Divorced**
WOMEN				
15-19	79.2	18.8	0.1	1.9
20-24	28.4	62.9	0.7	8.1
25-29	7.5	79.3	2.6	10.4
30-34	3.3	82.9	3.9	9.9
35-39	1.2	80.2	7.0	11.6
40-44	2.3	79.8	8.8	9.0
45-49	0.6	76.4	13.0	10.0
MEN				
15-19	98.2	1.6	0.0	0.2
20-24	73.5	24.7	0.0	1.8
25-29	32.2	61.5	0.6	5.7
30-34	5.8	84.8	0.8	8.6
35-39	1.9	90.0	0.0	8.0
40-44	2.1	90.4	0.6	6.9
45-49	0.9	91.2	1.0	6.9

Table A.38: Marital status by age and sex for Zimbabwe in 1999. The 'Marriage' category includes both formal and informal unions. Data source: Zimbabwe Demographic and Health Survey 1999.

Marital Status Zimbabwe 1999				
Age	**Never Married**	**Married**	**Widowed**	**Divorced**
WOMEN				
15-19	77.3	21.7	0.0	1.0
20-24	28.1	63.4	1.2	7.2
25-29	9.8	76.1	2.9	11.1
30-34	3.9	81.4	5.8	9.0
35-39	2.7	77.7	10.2	9.3
40-44	1.6	80.6	9.5	8.3
45-49	0.6	75.4	15.7	8.2
MEN				
15-19	99.2	0.6	0.0	0.1
20-24	76.4	21.8	0.1	1.6
25-29	27.0	65.8	1.4	5.8
30-34	7.5	85.3	1.7	5.5
35-39	5.9	88.3	2.9	2.9
40-44	2.1	91.6	1.9	4.5
45-49	1.3	89.0	4.2	5.6

Table A.39: Marital status by age and sex for Zimbabwe in 2005/06. The 'Marriage' category includes both formal and informal unions. Data source: Zimbabwe Demographic and Health Survey 2005/06.

Marital Status Zimbabwe 2005/06				
Age	**Never Married**	**Married**	**Widowed**	**Divorced**
WOMEN				
15-19	76.2	20.8	0.2	2.8
20-24	28.4	61.4	1.6	8.5
25-29	9.0	76.7	4.6	9.7
30-34	3.5	76.8	9.4	10.4
35-39	3.0	66.7	21.0	9.3
40-44	0.6	69.4	20.3	9.7
45-49	0.9	67.3	23.1	8.7
MEN				
15-19	99.3	0.4	0.0	0.2
20-24	75.5	21.3	0.0	3.2
25-29	29.0	64.1	0.8	6.2
30-34	6.6	85.6	1.4	6.4
35-39	4.5	87.6	3.2	4.6
40-44	2.0	88.4	5.4	4.1
45-49	1.3	90.2	4.9	3.7