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The Effect of the AIDS Epidemic on Economic Welfare in Sub-Saharan Africa

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Abstract

The existing literature on health and development contains increasing numbers of assessments of relations between health conditions of countries and their per capita gdp, but it has not assessed health as an *aspect* of economic welfare. Early work of Usher and more eecent work of Nordhaus and others has, however, begun to use empirical assessments of what societies appear willing to pay to reduce death rates (e.g. through costly environmental or safety regulations) to allow incorporation of mortality change into measures of changes in economic welfare that are more comprehensive than the rate of change in per capita gdp. This paper applies the method utilized by Nordhaus to assess the contribution of mortality changes in Sub-Saharan Africa to rates of change in economic welfare. Between 1960 and 1990 life expectancy in Africa increased by a very substantial 9 years. The impact was to add between 1.7% and 2.7% per annum to the growth rate of per capita gdp in generating a more inclusive measure of change in economic welfare. The AIDS epidemic, however, is more than reversing these gains: for Africa as a whole the AIDS-induced decline in economic welfare was about 1.7% per annum, leading to an overall growth rate of welfare of –2.6% . In countries heavily impacted by AIDS, Bostwana for example, the effect has been to decrease economic welfare by over 8% per year for the past decade.

THE EFFECT OF THE AIDS EPIDEMIC ON ECONOMIC WELFARE IN SUB-SAHARAN AFRICA

by

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Income levels and growth rates in Sub-Saharan Africa have lagged that of the rest of the world for at least the period from 1820, the earliest year for which assessments are available. Indeed, two decades into the post-colonial period, per capita income actually began to decline, from an average growth rate of a little over 1% per year in the 1960s and 1970s to –1.2% in the 1980s and –0.9% in the period 1990-96 (Bloom and Sachs, 1998). Yet for much of this period health conditions improved rapidly by historical standards (although not in comparison with other developing regions). For Sub-Saharan Africa as a whole life expectancy increased from 43 years in 1960 to 52 years in 1990 (World Bank, 1993). The unprecedented catastrophe of the African AIDS epidemic is now reversing earlier gains in health. By 1990 AIDS had already penetrated deeply into many countries in Africa, but the number of deaths remained fairly small (218,000 out of an estimated 7,940,000 deaths in 1990, or 2.7% of the total). By 1999, however, the number of African AIDS deaths had increased to 2,150,000, or 20.6% of total deaths, with projections for continued increases (World Health Organization, 2000; UNAIDS and World Health Organization, 2001). Our purpose in this note is to estimate the effect of the epidemic on changes in economic welfare for Sub-Saharan Africa as a whole and for five particularly heavily impacted countries in East Africa. To calculate changes in overall economic

welfare we use existing methods to impute a value to changes in mortality and add that change to the change in income conventionally defined.

1. Background

Health changes in Africa have been large: The 9-year improvement in life expectancy in Sub-Saharan Africa between 1960 and 1990 substantially exceeded the 6-year improvement during that period in the high-income countries. By the late 1980s, however, the AIDS epidemic began to reverse decades of mortality decline in an increasing number of African countries. For Africa as a whole the effects on the working-age population had become substantial by the year 2000 (Table 1), although under-15 mortality rates continued their previous declines (although only at a slower rate). Figure 1 shows mortality rates by age for females in 1990 and 2000: the age-specific mortality curve in middle ages deteriorates dramatically in the period 1990 to 2000. Figure 2 presents data over a longer period for two countries, Botswana and Malawi. This note will be using annual probabilities of death in its analyses, and Figure 2 shows that probability averaged over the age groups between birth and age fifteen and 15 and 60. After a period of slow but steady decline from 1960 to 1985, mortality rates trend sharply upward from 1985 on, particularly for Botswana.

A recent literature has examined the link between income change and mortality change, and has addressed the question of whether relatively slow income growth in Africa results in part from its realizing slower reductions in morbidity and mortality than have developing countries in other parts of the world. This literature has on the whole concluded that relatively slow improvements in health conditions (and consequent demographic changes) have indeed been an important determinant of Africa's relatively low income growth rates (Bloom and Sachs, 1998; Gallup and Sachs, 2001).

Without the health improvements that have in fact occurred, however, per capita income growth rates would probably have been significantly lower; Jamison, Lau and Wang (2001), estimate that Kenya and Zambia, for examples, would have grown 0.5% per annum more slowly if adult mortality rates had remained unchanged rather than declines between 1965 and 1990.

Several investigators have directly assessed the impact of the AIDS epidemic on per capita income on countries in Sub-Saharan Africa (Bloom and Mahal, 1997; Coddington and Hancock, 1994; Over, 1992). They find only a modest impact but, as Bloom and Mahal stressed, the finding of a modest impact conveys only limited welfare implications: If income loss in the numerator is balanced by population loss from early death in the denominator, a conclusion of 'no welfare change' is clearly inappropriate. Comparisons of per capita income are most appropriately done by comparing expected *lifetime* income per capita using alternative survival curves. We provide an illustration of this for Botswana later in this note. That said, our own calculations suggested that the impact of increase in male adult mortality rates between 1990 and 2000 (Table 1) would result in a drop of a very substantial 0.5% per annum in the growth rate of gdp per capita in Africa (Jamison, Lau and Wang, 2001, Model 9). This underestimates the impact of the AIDS epidemic since, virtually certainly, the adult mortality for Africa would have declined absent the epidemic.

The literature on health and development in Africa that we have just summarized deals with health as a determinant of per capita income, not as an aspect of economic welfare. Usher (1973) and, more recently, Nordhaus (1999, 2000) and other investigators have used studies that placed economic values on lives (or, more typically, on changes in the probability of death) to generate an expanded concept of national income that explicitly incorporates changes in health status into measures of overall economic welfare. Our main purpose in this note is to use Nordhaus's

approach to assess the contribution of health changes in general, and the AIDS epidemic in particular, to economic welfare changes in Sub-Saharan Africa. (Throughout this note we use 'income' to denote what is calculated in national accounts and 'economic welfare' to denote income augmented to account for the value of changes in mortality rates.)

Incorporating mortality into assessment of economic welfare substantially changes the qualitative picture of trends over time. Economic welfare in Sub-Saharan Africa grew more substantially than per capita gdp until about 1985 or 1990, depending on the country. More recently the AIDS epidemic has led to a rate of decline in economic welfare that far exceeds the rate of gdp decline. We assess this decline from 1990 for Africa as a whole, and we assess both improvements to 1985 and subsequent decline for five countries of eastern Africa. A concluding section conveys a complementary perspective by estimating the effect of the AIDS epidemic on individuals' expected lifetime earnings and on the rate-of-return to education in Botswana.

2. Methods: Assessing the Impact of Mortality Change on Change in Economic Welfare

An extensive literature has developed around empirical assessments of societies' willingness to pay to avert an adult death. The findings range from about 75 to over 180

times per capita gdp.[1] For the purposes of this analysis we will conservatively assume the number to be 100. The assumption is in any case easily altered, and a larger assumed value would increase our already very substantial estimates of the effects of mortality change on economic welfare.

Less research is available concerning child deaths. Although interesting results from the anthropological literature suggest that deaths in late childhood may be viewed as more significant than adult deaths, limited estimates from the cost-effectiveness literature give values of an infant death at about 25% to 50% of an adult death (IOM, 1987; Jamison et al 2002). In this paper we will include changes in child mortality into our estimates of change in economic welfare assuming the welfare loss for a child death (under age 15) to be adequately represented by changes in welfare associated with changes in adult death rates to represent the population as a whole. Trends in mortality rates for the age ranges from 0 to 5 and 0 to 15 appear in Table 2 for selected countries of east Africa and in Table 1, for Africa as a whole for the age group 0 – 15. (Sensitvity analysis to alternative assumptions can be undertaken using the reasonable assumptions that 45% of the population is under 15 and 5% over age 60.)

Nordhaus (1999) describes two closely related approaches for incorporating mortality changes into an expanded national income framework. One approach is based on changes in life expectancy (what Nordhaus calls the life-year approach) and the other is based on changes

[1] Jones-Lee (1994) summarized 26 relevant studies (16 of which he categorizes as 'good'), but all are from high-income environments. Jamison (2002) provides an introduction to the literature on monetary valuation of health outcomes with references to a now extensive literature. The underlying conceptual issues are increasingly being clarified in the theoretical literature – see Grossman (2000), Johansson (2001) and Rosen (1994) for valuable treatments of these issues.

in annual mortality probabilities (the mortality approach).[2] We use the mortality approach.

The mortality approach simply values a mortality change by multiplying that change by the value of a life. In terms of per capita gdp, a 0.2% change in the adult mortality rate in Africa between 1990 and 2000 would generate a loss of 0.2 times per capita income (assuming the value of a life equals 100 times per capita gdp), multiplied by the proportion of adults in the total population. That is, economic welfare per capita would have been 10% higher than the actual per capita gdp had mortality remained unchanged and assuming, as is reasonable, that adults constitute 50% of the population. This would correspond to a rate of decrease in economic welfare due to mortality increases of about 1% p.a.

The method just described for estimating effects of mortality changes on growth requires estimates of annual mortality rates, when what is usually provided is life expectancy or mortality over an age interval. (Demographers use the notation x q y for the probability of dying in the y years following age x at the then prevailing age-specific mortality rates.) To calculate the annual probability of dying averaged over a relevant age group, we first used available data sources to obtain estimates for under-15 mortality rates (the probability of dying between birth and age 15) and adult mortality rates (the probability of dying between age 15 and age 60). For specific countries for the year 2000 we used the World Bank life tables for the country. For earlier years we used the Bank's estimates of child mortality and converted the Bank's estimates of male and female life expectancy into estimates of adult

[2] Neither approach deals completely with non-steady state conditions, and this has implications for the dynamic environment of the AIDS epidemic in Africa. Our estimates for the period before 1985 are little affected. Our post-1985 estimates of the effect of the AIDS epidemic will need to be adjusted downward, if only slightly.

mortality from the Coale-Demeney "North" model life tables.[3] From these numbers we calculated the average annual mortality rate, m, over the relevant age range with the following formula (here for under-15 mortality, 15q0):

$$(1 - m)^{15} = 1 - 15q0, \text{ or } m = 1 - \exp\{\ln(1 - 15q0) / 15\} .$$

Tables 1 and 2 convey the mortality data we use in our analyses. Table 1 is for Sub-Saharan Africa as a whole; Table 2 presents data over a longer time period for 5 countries in eastern Africa. In Table 2, for the year when life expectancy is at a maximum (or mortality rates are at a minimum) the relevant entries appear in bold face. (Table 2 also includes estimates of the child mortality rate, 5q0, to make the point that most – but far from all – of under-15 mortality occurs under age 5. Inclusion of 5q0 permits others, if they wish, to value under-5 deaths differently from those between 5 and 15.)

3. Mortality Change and Economic Welfare in Africa

Sub-Saharan Africa varies enormously from country-to-country in the scale and extent of progression of the AIDS epidemic. Nonetheless, by the year 2000, the epidemic had on average progressed sufficiently far that mortality rates (in middle ages) had increased substantially for the continent as a whole (Figure 1). Table 1 showed the evolution of the probability of dying between age 15 and age 60 (45q15) between 1990 and 2000. (Life

[3] The adult mortality rate is given by the following empirical relations: for males (45q15) = -0.0107 (life expectancy) + 0.9087; and for females, 45q15 = -0.0102 (life expectancy) + 0.921.

tables for Africa as a whole are unavailable for years prior to 1990.) In 1990 males had a 51% chance of dying between these ages, and this had increased to 57% by 2000. For females the increase was from 45 to 53% . (By comparison, in Japan the 1999 45q15 for females was only 4.8%. WHO, 2000.)

Taking the average of the change in annual mortality probabilities (0.3% for males and 0.4% for females) gives 0.35% over the 10-year period from 1990. Again using 100 times per capita gdp as the value of a death averted, economic welfare would have been 1.35 times higher in 2000 if mortality rates had remained unchanged. This corresponds to incomes being 27% lower than it would otherwise have been, or to a decline in the growth rate by 1.7% . Since the per capita gdp growth rate in the 1990s was -0.9% p.a. the overall rate of decline was -2.6% , two thirds of which is due to the economic welfare loss associated with mortality increase.

An alternative way of assessing the effect of mortality increase due to AIDS on economic welfare is to start from the estimated number of disability adjusted life-years (DALYs) from AIDS in Sub-Saharan Africa, which was about 74.5 million in 1999 (WHO, 2000). A death at age 35 corresponds to about 26 DALYs (World Bank, 1993), so 75 million DALYs would correspond to 2.8 million adult deaths.[4] If 90% of AIDS deaths are in adults then adult DALYs from AIDS would correspond to about 2.5 million adult deaths per year. The population of Sub-Saharan Africa was 616 million in 2000, and 2.5 million divided by 616 million is 0.40% , somewhat higher then the 0.35% increment in death rate derived

[4] Note that DALYs include a measure of loss associated with disability in addition to premature mortality. Hence the number of AIDS deaths would be substantially less than 2.8 million indicated to be equivalent in terms of DALYs lost.

from the UN's mortality estimates from Table 1. It is reasonable that the DALY-derived number should be somewhat higher because the time trend in non-AIDS deaths was favorable and because the DALY measure includes morbidity as well as mortality. Table 3 divides countries of Sub-Saharan Africa into the WHO's two mortality strata for the region and illustrates vividly how the impact of the AIDS epidemic varies across the continent.

Prior to 1985, though, improvements in adult health would have led to increases in economic welfare relative to what is captured by per capita income. Table 3 shows data on this for 5 countries of eastern Africa. The estimated effect is to add between 1.7 and 2.7% per annum to the growth rate of economic welfare. This changes the overall perception of performance: Malawi, for example, goes from having a slightly negative per capita income growth rate to a rather larger positive growth rate of economic welfare.

These five countries are ones that have been affected early and substantially by the epidemic. The final column of Table 4 shows the enormous impact on the annual rate of growth in economic welfare. The rates of decline lie between 5 and 8% per annum over the 15-year period 1985 to 2000. This declines would more than reverse gains in per capita income under circumstances of favorable growth; here they generate strongly negative growth in economic welfare.

4. The Effect of AIDS on Lifetime Earnings and the Returns to Education in Botswana

Our primary purpose in this note has been to assess the effect of changes in health status on changes in economic welfare, where change in economic welfare is construed to include valuation of

changes in mortality. To complement that analysis we also consider the effects of the epidemic on expected lifetime earnings and the rate of return to education. Per capita income as a measure of welfare fails to reflect welfare losses of the prematurely dead, but the closely related concept of expected lifetime earnings captures these effects. We examine these effects for Botswana, where the survival curves (Figure 3) show the dramatic impact of AIDS mortality on the length of the working life.

Since recent age-earnings profiles for Botswana are unavailable, we use curves based on a World Bank analysis of 1999 data from Madagascar with earnings expressed as a fraction of per capita gdp. While conditions in Botswana will of course differ from those in Madagascar, the Madagascar curves reflect typical patterns and will provide an adequate approximation. Figure 4 plots the age-earnings profiles that we will use for males with 9 and 12 years of education.

A 22-year old male with 12 years of education could expect lifetime earnings of slightly over 100 times per capita income assuming no change in the age-earnings profile over time, no discounting and the survival pattern shown in curve C of Figure 3. (Curve C is the projected male survival curve for the year 2000 in Botswana assuming no AIDS epidemic.) With discounting at a constant rate r, lifetime income is simply given by:

$$\sum_{t=0}^{43} Y_{12}(t) \quad S(t) \quad (1 + r)^{-t},$$

where Y_{12} is the age-earnings function with 12 years of education, and s(t) is the probability of surviving for t years from age 22. Survival curve A, the observed curve in Botswana for 2000,

reflects the consequences of the AIDS epidemic to date. With this mortality profile, expected lifetime earnings without discounting decline from 101 to 61 times per capita income. That is, without AIDS (but adjusting for other sources of mortality) expected lifetime income would be about 66% higher than with AIDS. Discounting (at 3% p.a.) changes the numbers slightly, but not the qualitative picture: The present value of earnings decreases from 55 to 36 times income per capita, i.e. by an average of about 1.5% per year over 15 years.

Mortality increases also affect income growth by reducing the rate of return to education. Meltzer (1992) reviews the relevant literature and presents estimates of his own to the effect that mortality changes in general and the AIDS epidemic in particular can have a strong effect on the incentive to invest in education. Our calculations using the mortality data from Botswana also find a major effect.

Under the assumption that the direct cost of secondary schooling is about 0.9 times per capita income (consistent with the sparse data from Africa – see World Bank, 2000) and that it on average takes 4 years to complete the cycle from grade 10 through 12, the internal rate-of-return from going to 12^{th} grade completion from 9^{th} grade completion is given by the standard formula, i.e. by the value of r that makes the present value of benefits equal the present value of costs:

$$\sum_{t=3}^{47} (Y_{12}(t) - 0.9\,Y_0) S(t) (1+r)^{-t} = \sum_{t=3}^{47} (Y_{12}(t+18) - Y_0(t+18)) S(t) (1+r)^{-t}$$

where, as before, S(t) is the probability of survival for t more years given that one is alive at age 18. If S(t) is generated from Curve C of Figure 3 the rate-of-return is about 4% ; with AIDS

(curve A) the rate-of-return is more than halved to less than 2% . If the students were paying none of the direct cost, the 0.9 would disappear from the equation and the private rate-of-return would result from the calculation. Figure 5 shows how, in the presence of the AIDS epidemic, the present value of costs and benefits varies with the discount rate for both social costs and private costs. The private rate-of-return, too, is markedly affected by AIDS: the private rate-of-return declines from 7% to 5% , again a 2% absolute drop but a smaller proportional drop. An additional point to note here, as Figure 5 shows, is that cost recovery for education in this context has an effect on the private rate-of-return comparable to that of the AIDS epidemic.

The numbers presented here are meant to be reasonable representations, not precise estimates. The general story they tell complements the earlier assessment of the epidemic's effect on welfare broadly defined. The economic consequences are major indeed, and result in correspondingly large changes in incentives -- in this example in the incentive to invest in education.

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Table 1
Changes in Under-15 and Adult Mortality Rates for Sub-Saharan Africa as a Whole, 1990-2000

	Males				Females			
Year	15q0 (%)	m_c	45q15 (%)	m_a	15q0 (%)	m_c	45q15 (%)	m_a
1990	22.0%	1.64%	51.1%	1.58%	20.6%	1.52%	45.0%	1.32%
1995	20.4%	1.51%	54.2%	1.72%	19.0%	1.40%	49.0%	1.49%
2000	18.6%	1.36%	57.2%	1.87%	17.4%	1.26%	53.0%	1.66%

Note: Figures in the tables are estimates (or projections) of averages for the 5 years following the indicated years.

Definitions:
1. 15q0 is the probability of dying in the 15 years following the birth at the then prevailing mortality rates.
2. 45q15 is the probability of dying in the 45 years following the 15th birthday at the then prevailing mortality rates.
3. m_c is the annual probability of dying for children, expressed as a % , averaged from age 0 to age 15.
   m_a is the acomparable figure for adults.

Source: United Nations Population Division.

Table 2:
Changing Levels of Mortality in Five African Countries, 1960-2000

Panel A: Botswana

	Male			Female			Under-15		Under-5	
Year	e(0) (years)	45q15	m	e(0) (years)	45q15	m	15q0	m	5q0	m
1960	46	41.8%	1.2%	49	42.0%	1.2%	21.1%	1.6%	17.0%	3.7%
1965	48	39.3%	1.1%	52	39.3%	1.1%				
1970	52	35.8%	1.0%	55	36.1%	1.0%	17.3%	1.3%	13.9%	2.9%
1975	55	32.4%	0.9%	58	32.8%	0.9%				
1980	57	30.1%	0.8%	62	29.1%	0.8%	11.7%	0.8%	9.4%	2.0%
1985	**59**	27.8%	0.7%	**63**	28.1%	0.7%				
1990	52	34.8%	0.9%	56	35.3%	1.0%	7.7%	0.5%	6.2%	1.3%
1995	46	41.4%	1.2%	48	42.8%	1.2%				
2000	38	80.3%	3.5%	38	76.0%	3.1%	13.1%	0.9%	10.6%	2.2%

Panel B: Kenya

	Male			Female			Under-15		Under-5	
Year	e(0) (years)	45q15	m	e(0) (years)	45q15	m	15q0	m	5q0	m
1960	44	43.8%	1.3%	48	43.2%	1.2%	25.4%	1.9%	20.5%	4.5%
1965	47	41.1%	1.2%	51	40.7%	1.2%				
1970	49	38.4%	1.1%	53	38.1%	1.1%	19.4%	1.4%	15.6%	3.3%
1975	52	35.8%	1.0%	56	35.6%	1.0%				
1980	54	33.4%	0.9%	58	33.1%	0.9%	14.3%	1.0%	11.5%	2.4%
1985	**56**	31.3%	0.8%	**60**	31.5%	0.8%				
1990	55	31.7%	0.8%	58	32.6%	0.9%	12.0%	0.9%	9.7%	2.0%
1995	50	37.9%	1.1%	50	41.2%	1.2%				
2000	45	61.8%	2.1%	46	58.1%	1.9%	15.6%	1.1%	12.6%	2.6%

Panel C: Malawi

	Male			Female			Under-15		Under-5	
Year	e(0) (years)	45q15	m	e(0) (years)	45q15	m	15q0	m	5q0	m
1960	38	50.4%	1.5%	39	52.3%	1.6%	44.8%	3.9%	36.1%	8.6%
1965	39	49.2%	1.5%	40	51.2%	1.6%				
1970	40	47.7%	1.4%	42	49.6%	1.5%	41.0%	3.5%	33.0%	7.7%
1975	42	45.6%	1.3%	44	47.6%	1.4%				
1980	44	43.5%	1.3%	46	45.5%	1.3%	32.9%	2.6%	26.5%	6.0%
1985	**45**	42.6%	1.2%	**47**	44.6%	1.3%				
1990	43	44.4%	1.3%	44	47.1%	1.4%	28.5%	2.2%	23.0%	5.1%
1995	41	47.3%	1.4%	41	50.7%	1.6%				
2000	36	69.0%	2.6%	37	64.7%	2.3%	28.8%	2.2%	23.2%	5.1%

Table 2, continued

Panel D: Zambia

	Male			Female			Under-15		Under-5	
Year	e(0) (years)	45q15	m	e(0) (years)	45q15	m	15q0	m	5q0	m
1960	41	46.8%	1.4%	44	46.9%	1.4%	26.4%	2.0%	21.3%	4.7%
1965	44	44.1%	1.3%	47	44.3%	1.3%				
1970	46	42.0%	1.2%	49	42.2%	1.2%	22.5%	1.7%	18.1%	3.9%
1975	48	39.8%	1.1%	51	40.2%	1.1%				
1980	**50**	37.3%	1.0%	**52**	38.7%	1.1%	18.5%	1.4%	14.9%	3.2%
1985	49	38.8%	1.1%	51	40.6%	1.1%				
1990	48	39.5%	1.1%	50	41.5%	1.2%	24.1%	1.8%	19.4%	4.2%
1995	43	44.9%	1.3%	43	48.0%	1.4%				
2000	37	75.0%	3.0%	37	70.7%	2.7%	23.0%	1.7%	18.5%	4.0%

Panel E: Zimbabwe

	Male			Female			Under-15		Under-5	
Year	e(0) (years)	45q15	m	e(0) (years)	45q15	m	15q0	m	5q0	m
1960	45	42.8%	1.2%	48	43.1%	1.2%	19.7%	1.5%	15.9%	3.4%
1965	47	40.2%	1.1%	51	40.5%	1.1%				
1970	50	37.6%	1.0%	53	37.8%	1.0%	17.1%	1.2%	13.8%	2.9%
1975	52	35.2%	1.0%	56	35.5%	1.0%				
1980	54	33.3%	0.9%	58	33.4%	0.9%	13.4%	1.0%	10.8%	2.3%
1985	**55**	31.8%	0.8%	**59**	32.3%	0.9%				
1990	54	33.3%	0.9%	58	33.4%	0.9%	9.4%	0.7%	7.6%	1.6%
1995	44	43.7%	1.3%	45	46.3%	1.4%				
2000	39	75.0%	3.0%	39	73.2%	2.9%	15.5%	1.1%	12.5%	2.6%

Note:
1. For each country the row for the year in which life expectancy is the largest has been put in boldface.
2. Figures in the table are estimates (or projections) of averages for the 5 years following the indicated years.

Definitions:
1. e(0) is life expectancy at birth.
2. 45q15 is the probability of dying in the 45 years following the 15th birthday at the then prevailing mortality rates. 5q0 and 15q0 are the probabilties of dying in the 5 years, or the 15 years, following live birth at the the then prevailing mortality rates.
3. m is the annual probability of dying, expressed as a %, averaged over the years in the relevant age group.

Source: World Bank data files.

Table 3.
Countries in the WHO Africa Region by Mortality Stratum, 1999

Aggregate demographic and disease burden data	High child mortality High adult mortality	High child mortality Very high adult mortality
	Algeria	Bostwana
	Angola	Burundi
	Benin	Central African Republic
	Burkina Faso	Congo
	Cameroon	Cote d'Ivoire
	Cape Verde	Democratic Republic of the Congo
	Chad	Eritrea
	Comoros	Ethiopia
	Equatorial Guinea	Kenya
	Gabon	Lesotho
	Ghana	Malawi
	Guinea	Mozambique
	Guinea-Bissau	Namibia
	Liberia	Rwanda
	Madagascar	South Africa
	Mali	Swaziland
	Mauritania	Uganda
	Mauritius	United Republic of Tanazania
	Niger	Zambia
	Nigeria	Zimbabwe
	Sao Tome and Principe	
	Senegal	
	Seychelles	
	Sierra Leone	
	The Gambia	
	Togo	
Total population	286,350,000	330,085,000
Total deaths	4,381,000	6,055,000
AIDS deaths	458,000	1,696,000
AIDS deaths as % of total deaths	10.5%	28.0%
Total DALYs	158,439,000	214,921,000
AIDS DALYs	15,778,000	58,671,000
AIDS DALYs as % of total DALYs	10.0%	27.3%

Source: WHO (2000; Annex Tables 3 and 4 and p. 204).

Table 4.
The Effects of Mortality Change on the Annual Rate of Growth of Economic Welfare, 5 East African Countries, 1960-2000.

	Growth rate of per capita gdp (%)			Contribution of health change to the rate of change in economic welfare (%)	
Country	1960-78	1980-90	1990-96	1960-85	1985-2000
Botswana		+7.3	+1.3	+2.7	-8.5
Kenya	2.2	+1.1	-0.9	+2.5	-5.3
Malawi	2.9	-0.5	+0.8	+1.7	-5.3
Zambia	1.2	-1.9	-1.9	+1.7	-7.9
Zimbabawe	1.2	+0.8	-0.5	+2.0	-7.5

Sources: GDP growth rates are from World Bank (1980) for 1960-78 and World Bank (2000).

Figure 1:
Age-Specific Mortality Rates (1 q x) for Females in Sub-Saharan Africa in 1990 and 2000

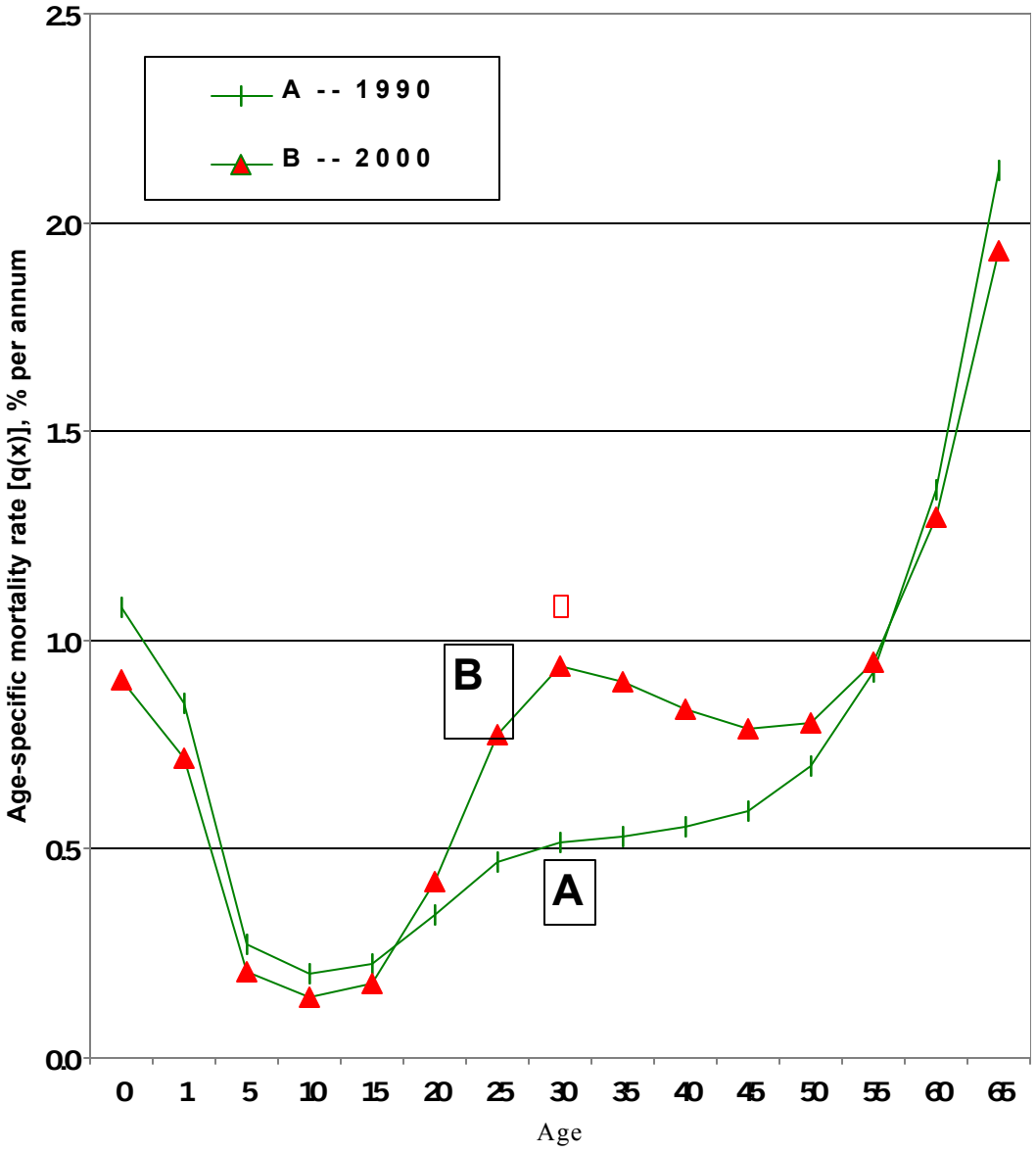


Figure 2:
Annual Mortality Rates of Adult Males, Botswana and Malawi, 1960-2000

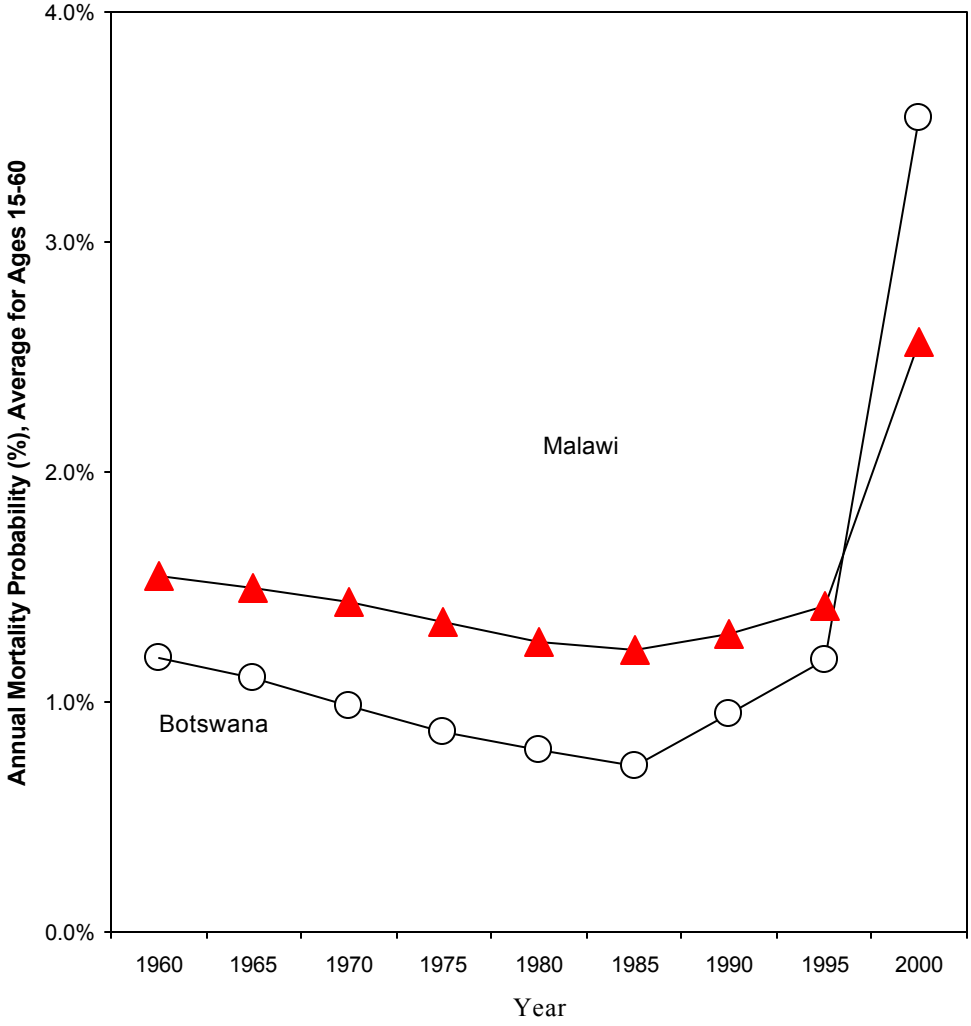


Figure 3:
The Effect of AIDS on the Male Survival Curve in Botswana, 1987-2000

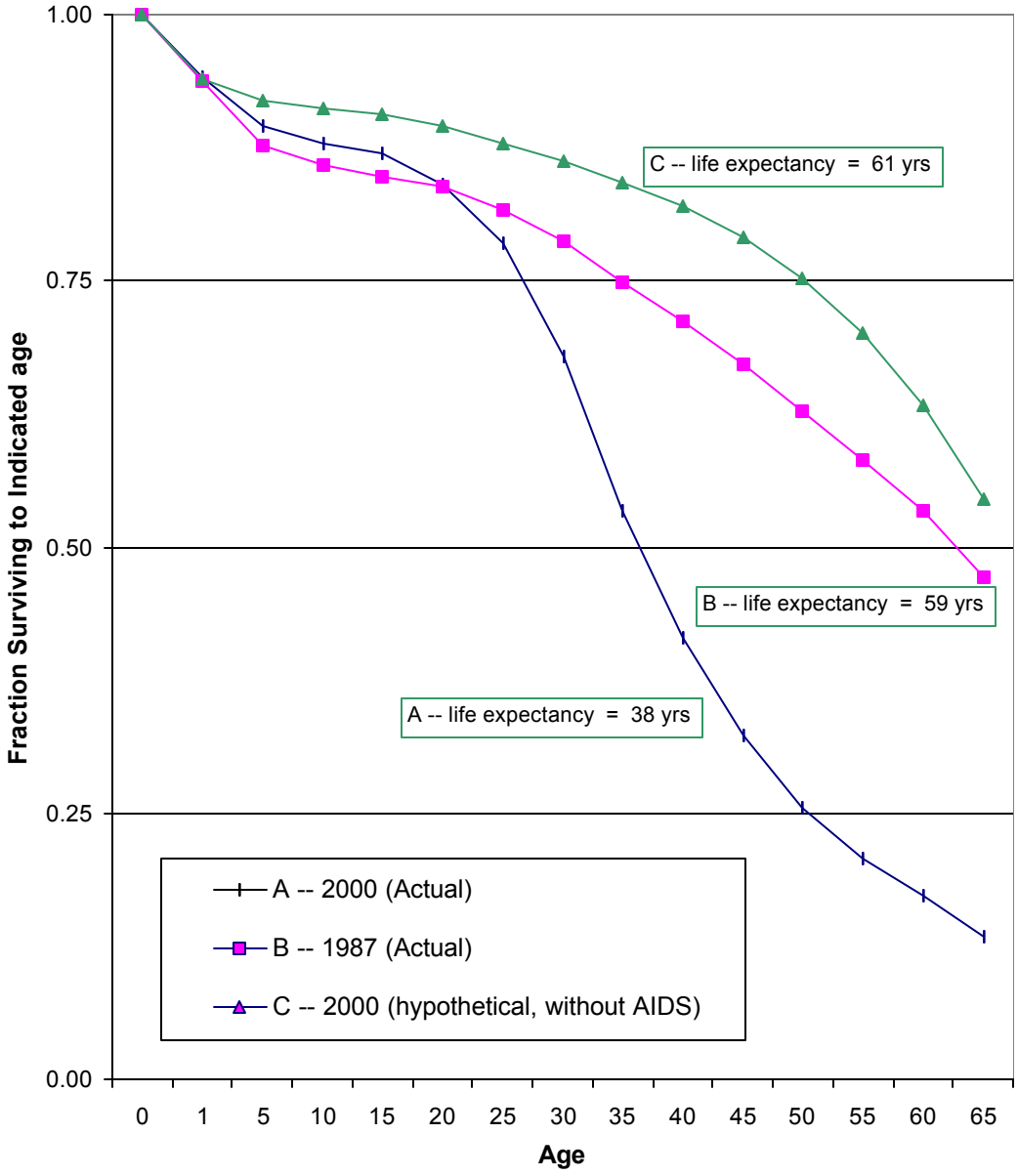


Figure 4:
Illustrative Age-Earnings Profile for Males in the Formal Sector, Africa, Late 1990s

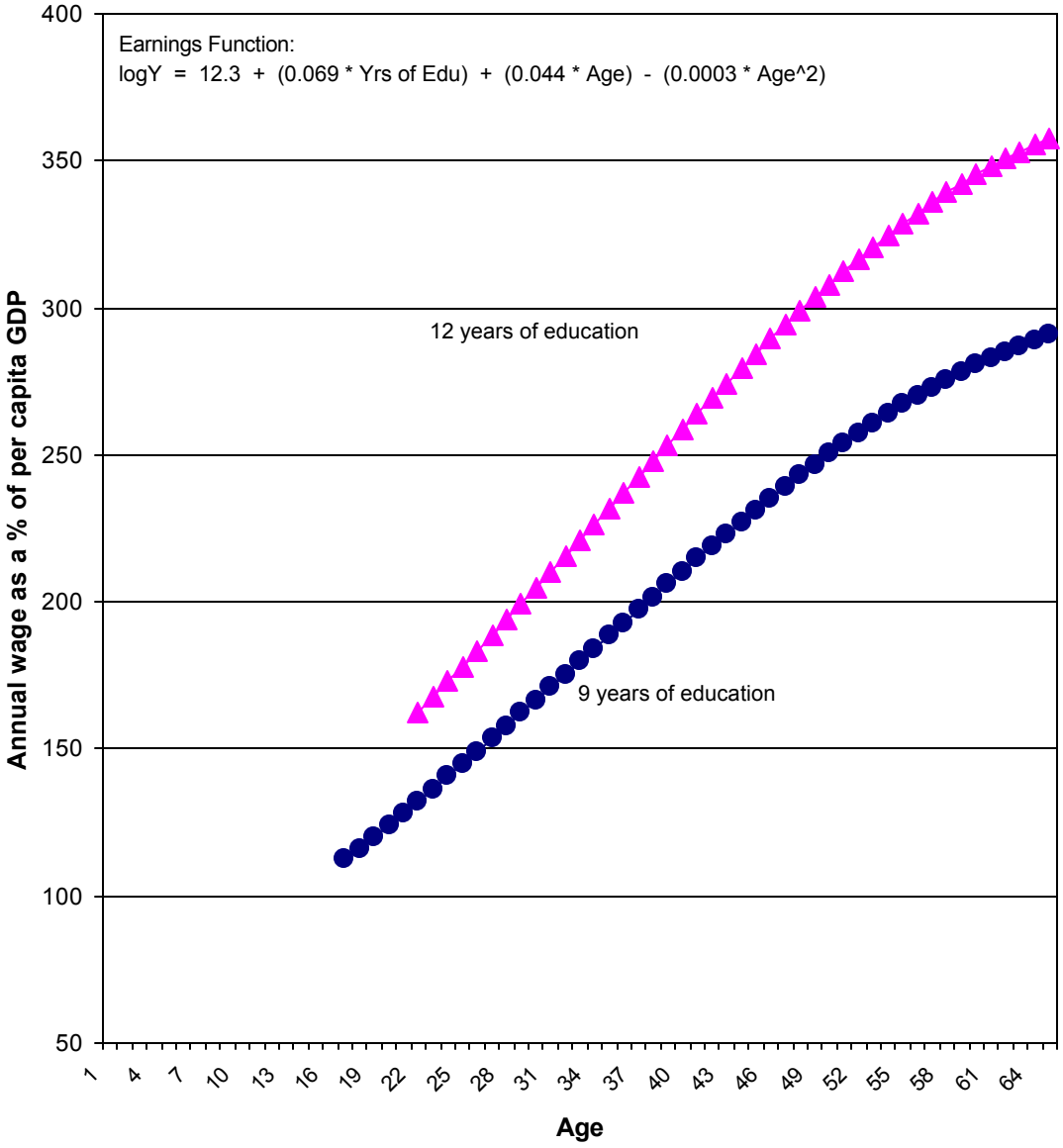
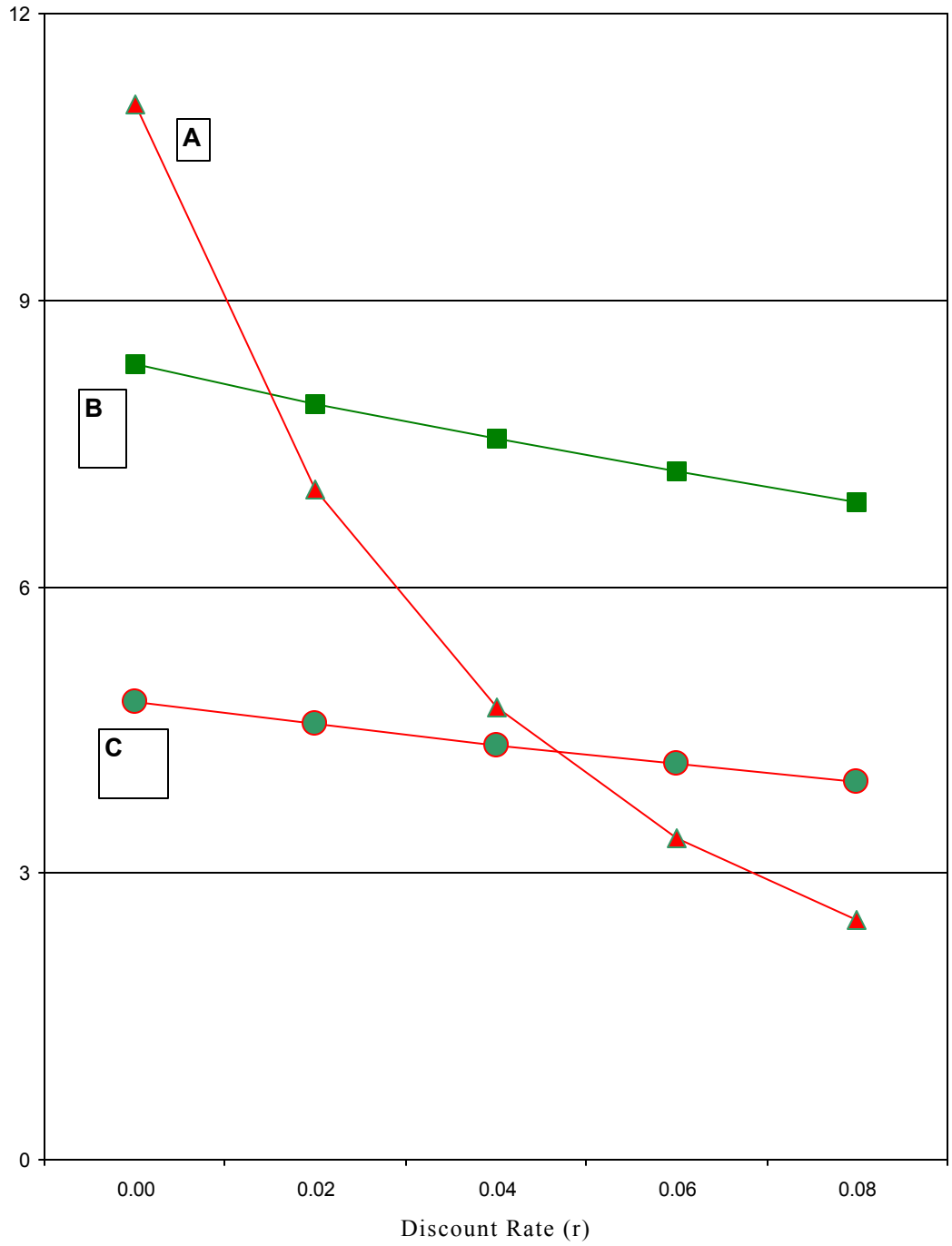


Figure 5:
The Effect on Rate-of-Return of Cost Recovery in Secondary Education, Botswana, 2000



A: Present value of earnings differential, 12 vs 9 years of education (this is calculated from the year 2000 life table incorporating the efefct of AIDS on mortality.
B: Present value of social costs (or private costs with cost recovery).
C: Present value of private costs with no cost recovery.