HIV/AIDS and its impact on convergence in life expectancy, infant and child survival rates

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This article analyzes the impact of HIV/AIDS on the global convergence in life expectancy as well as infant and child survival rates by comparing two scenarios. One is based on actual estimated and extrapolated values given the existence of the epidemic ('AIDS-scenario'). The other is based on hypothetical values based on estimations where the mortality caused by the epidemic is taken out ('No AIDS-scenario'). Both β- and σ-convergence analysis is undertaken both with and without weighting by population size. In the 'AIDS-scenario' convergence in life expectancy becomes stalled in the late 1980s (without weighting) or 1990s (with weighting). Convergence in infant and child survival rates does not become stalled, but slows down. That these results are mainly due to the epidemic follows from the convergence analysis in the 'No AIDS-scenario', where all signs of stalled convergence or even divergence disappear. The reason why HIV/AIDS has such a strong impact on convergence is because the disease is most prevalent in low-income countries with rampant poverty, deficient health care systems and relatively low life expectancies and survival rates.

Introduction

For the most part of the last century there has been convergence in three fundamental aspects of the quality of life: Infant and child survival rates as well as life expectancy have increased faster over time in countries with low survival rates and low life expectancy than in countries with high survival rates and high life expectancy.[1] Whilst not undisputed (see, for example, Hobijn and Franses (2001) and Mazumdar (2003)), most analysts of convergence in the quality of life have hailed this development as a great achievement and success (Ram and Schultz (1979); Ram (1982, 1998, 2003); Ingram (1994); Easterlin (2000); Sab and Smith (2001); Neumayer (2003), Kenny (2003); Becker, Philipson and Soares (2003)).

What has been relatively neglected is that the convergence in life expectancy came to a halt at the end of the 20th century, even, according to some estimations, turning into divergence. Wilson (2001), Neumayer (2003) and Ram (2003) are three exceptions to this neglect. Wilson (2001, p. 167) merely notes that 'between1975-80 and 2000 several countries in southern Africa saw life expectancy decline substantially following the spread of HIV/AIDS' in his analysis of global demographic convergence. Neumayer (2003, p. 294) demonstrated the divergence and speculated that it might be explained by 'social upheaval in many countries of transition particularly in what used to be the former Soviet Union, together with the spread of AIDS and urban violence in many developing countries'. Ram (2003) goes further and tests whether the results from convergence analysis change if the twelve countries most highly affected by the Human Immunodeficiency Virus (HIV) and the Acquired Immuno-Deficiency Syndrome (AIDS) are taken out of the sample.[2] He weighs observations by population size and examines convergence by looking at so-called β-convergence (regressing growth on initial values) and σ-convergence (the standard deviation and Theil's (1979) inequality index). He finds that the exclusion of these countries has a significant impact. First, whereas there is no evidence for β-convergence in life expectancy over the

period 1980 to 2000 in the full sample, there is convergence in the restricted sample. Looked at the decade of the 1990s only, there is divergence (rather than convergence) in life expectancy in the full sample, but neither convergence nor divergence in the restricted sample. In terms of σ-convergence, the divergence in the 1990s is less pronounced in the restricted sample.

This article explores the impact of HIV/AIDS on convergence in fundamental aspects of the quality of life in much greater detail. First, in addition to life expectancy we also address infant and child survival, that is survival beyond the age of one and the age of five, respectively. Second, in addition to analyzing the past record, we also look at the predicted convergence trend in the future. Third, we tackle the impact of the epidemic more comprehensively in analyzing and comparing convergence trends in an 'AIDS-scenario' and a 'No AIDS-scenario'. The first scenario is one of actual estimated and extrapolated survival rates and life expectancies. The 'No AIDS-scenario', on the other hand, is based on survival rates and life expectancies taking out the estimated mortality caused by the epidemic. We will show that HIV/AIDS has caused divergence in life expectancies that will stay with us for another decade or so. The epidemic has not led to divergence in infant or child survival rates, but it has slowed down convergence in these indicators of the quality of life.

This article is structured as follows. The next section provides background information on the impact that HIV/AIDS has had on mortality in the most severely affected countries. This is followed by an explanation of the two scenarios, a description of the sources of data and the tools of convergence analysis used. Results are reported and the final section draws conclusions from the evidence presented.

HIV/AIDS and the mortality crisis in the most severely affected countries

HIV/AIDS has become the 'deadliest epidemic in contemporary history' (UNPD 2003, p. 2) of mankind. By the end of 2003, between 34 and 46 million people are estimated to live with HIV/AIDS, 4.2 to 5.8 million of which were newly infected in that year. 2.5 to 3.5 million AIDS deaths occurred during 2003 (UNAIDS and WHO 2003, p. 3). AIDS now represents the fourth most important cause of death world-wide and the leading cause in Sub-Saharan Africa, the region most severely affected hosting about 70 per cent of all infected persons. Within this region, the seven most affected countries are Botswana, Lesotho, Namibia, South Africa, Swaziland, Zambia and Zimbabwe (UNPD 2003). See Philipson and Posner (1995) and Caldwell (2000) for a discussion of the many reasons why Sub-Saharan Africa is so particularly hard hit by the epidemic.

Whilst most countries severely affected by the epidemic seem to have reached the peak of HIV incidence, prevalence is estimated to peak only in this decade or the next due to the fact that many HIV-infected persons survive for a number of years before eventually dying from AIDS (UNPD 2003, table 3). Incidence, which is complicated and expensive to estimate, measures the number of new infections among the non-infected population during a period of time. Prevalence measures the percentage of the population living with HIV and is typically based on HIV tests on anonymous blood samples from women in antenatal clinics (UNAIDS and WHO 2003).

There are manifold demographic impacts of the epidemic. Due to the focus of this article, we will concentrate here on mortality and life expectancy rather than population size, population growth and population structure. In the absence of a cure, the most direct effect of the epidemic is to raise mortality. It is estimated that during the period 2000 to 2005 around 20 million more people will have died than would have in the absence of AIDS (UNPD 2003, table 6). Sub-Saharan Africa is again the region most severely hit, accounting for around 75

per cent of excess deaths. The maximum number of excess deaths will be reached after prevalence has peaked, which implies that the number can be expected to rise in most countries for another ten to fifteen years (UNPD 2003, p. 7).

The large regional and country differences in excess mortality also translate into large differences in terms of life expectancy. During the period 2010 to 2015, when the impact on life expectancy is projected to be strongest, life expectancy in the most severely affected Sub-Saharan African countries is estimated to be lowered by 11.3 years (or 19.3 per cent), whereas the relevant average figures for Asian countries are 2.1 years (or 2.9 per cent) and for Latin American and Caribbean countries 1.9 years (or 2.6 per cent). For the seven Sub-Saharan African countries with prevalence rates above 20 per cent of the population aged between 15 and 49, the loss of life expectancy is even more daunting with a loss of 29.4 years (or 43.9 per cent) in 2010 to 2015, which even in 2045 to 2050 will only have slightly decreased to 22.4 years (or 30 per cent) (UNPD 2003, table 7). One of the reasons why the effect on life expectancies is so strong is that most of the excess mortality due to AIDS affects the relatively young age groups between 25 and 49 years old.

Even infants and children are affected by the disease, not only indirectly by being orphaned if their parents die from AIDS, but also directly due to the transmission of the disease from infected mothers. Fortunately, the impact on infant and child mortality is far less pronounced than on general mortality or life expectancy. One of the reasons is that HIV-infected women have on average a lower fertility rate than non-infected women (UNPD 2003, p. 9). Even in the 38 most severely affected countries in Sub-Saharan Africa infant mortality is ‘merely’ raised by about 5 deaths per thousand births (or 5.3 per cent) in 2000 to 2005. The effect on mortality of children below the age of five is somewhat more pronounced at 7 deaths per thousand births (or 7.8 per cent) (UNPD 2003, table 10). The reason is that almost two thirds of HIV-infected children are estimated to survive beyond their first

birthday (UNPD 2003, p. 9). The figures are somewhat higher in the group of seven countries in this region with adult prevalence rates above 20 per cent. Their infant mortality is up by 14 deaths (or 27.2 per cent) and under-5 mortality is up by 41 deaths (or 56.4 per cent) (UNPD 2003, table 11). Contrary to life expectancy, HIV/AIDS is not projected to reverse the increasing trend in infant and child survival rates in any of the most affected countries.

We now want to examine the impact that the losses in life expectancy and the increase in infant and child mortality caused by HIV/AIDS have on global convergence in these fundamental aspects of the quality of life.

The 'AIDS'- and the 'No AIDS-scenario's

The 'AIDS-scenario' is based on estimates of observed past and current values of survival rates and life expectancies as well as their extrapolations into the future. The 'No AIDS-scenario' is based on estimations of what survival rates and life expectancies would be now or in the future if HIV/AIDS were in fact not existent. The United Nations Population Division (UNPD) explains how this is done in several steps (UNPD 2001, pp. 104-110). First, the countries are identified that are most severely affected by the epidemic and for which the disease has a significant effect on mortality. These countries are listed in the appendix and comprise 45 countries in the case of UNPD estimates (51 countries for U.S. Bureau of Census estimates).[3] In the UNPD case, countries are included if the estimated prevalence of HIV/AIDS among persons aged 15 to 49 exceeds 1.9 per cent. For countries with lower prevalence the epidemic is still largely confined to so-called high-risk groups implying too much uncertainty about the likely future course of the epidemic in these countries to take the epidemic into account in projections. The only exceptions are Brazil and India, which are included due to their large population size despite prevalence rates below the threshold (UNPD 2003, p. 2).[4] For the 45 countries, the annual number of newly infected

persons is estimated for past years. As a second step, the annual probability of acquiring HIV among persons aged 15 or over is estimated. This annual probability is then projected into the future (third step) in order to estimate the number of adults living with HIV/AIDS and dying of AIDS in the future (fourth step). These calculations are based on follow-up studies of HIV infected persons. By modeling the fertility of HIV-positive mothers and by assuming a fixed rate of transmission from mother to child together with assumptions about the probability of dying from AIDS, the number of deaths of infants and children under the age of five can be calculated (fifth step). Once the number of adult, infant and child mortality from AIDS has been estimated, these estimates can be incorporated into the estimates of future life tables to create a scenario that shows what the most likely values of life expectancy, infant and child mortality would be without AIDS (sixth step).

Of course, one of the difficulties of estimating the 'No AIDS-scenario' is that not all deaths of persons infected with HIV are directly attributable to AIDS. For this reason, UNPD considers only 95 per cent of adult deaths of HIV-infected persons as being caused by AIDS. For HIV-positive children the respective shares are region-specific: 96.5 per cent in Myanmar and Sub-Saharan African countries, 97.7 per cent in other countries of Asia, 99.4 per cent in Brazil and 99 per cent in other countries of Latin America and the Caribbean (UNPD 2001, p. 109f.).

We take historical data on life expectancy and infant mortality from the UNPD and data on mortality of children under the age of five from the United Nations Children Fund (UNICEF). The UNDP also provides extrapolations into the future until 2050. These data are compiled and distributed by the same source used here, namely the United Nations Common Statistical Database (UN 2003). For the 'No AIDS-scenario', UNPD (2001) provides estimates for the under-5 mortality rate in 2000 and 2010 and UNPD (2003) for life expectancies in the years 2005, 2015 and 2050. For infant mortality, the UNPD provides only

some older estimations and for 34 most severely affected countries only (UNPD 2000). For this reason, we use estimates from the United States Bureau of Census (Way 2003) of the percentage difference between infant mortality in the 'AIDS'- and 'No AIDS-scenario's to calculate infant mortality rates in 2002 and 2010 for the 'No AIDS-scenario'.[5] The mortality rates were converted into survival rates by subtracting them from 1000.

Tools of convergence analysis

One can define convergence as follows: Countries converge in a variable of interest if the dispersion of the variable is shrinking over time. As our tools of convergence analysis we test for what is commonly known as β-convergence and σ-convergence. β-convergence implies regressing the growth rate in life expectancy or survival rates on the initial level. This is typically done in a log-transformed model:

$$\ln(x_{it}/x_{i0}) = \alpha + \beta \cdot \ln(x_{i0}) + e_i$$

where i stands for each country and t is a count of years after base year zero. If the estimated β-coefficient is negative and statistically significant, then we infer that countries have converged on the dependent variable. A statistically significant positive coefficient sign leads us to conclude that countries have diverged instead. If the coefficient is statistically insignificant, whether positive or not, we cannot conclude either way and say that we observe neither convergence nor divergence.

By analyzing β-convergence in a log-transformed model, one implicitly assumes that the distance of points within the distribution of the variable of interest is measured in percentage terms. This might be a plausible way of measuring distance, but it can also overstate convergence since the same absolute amount of change in a variable translates into

a smaller change in the log of that variable at higher values. Frontrunners will find it increasingly difficult to run ever further away if the variable of interest is analyzed in its logged form. An alternative is therefore to analyze convergence of a variable without log-transformation, that is, in level form. To save space and because the log-model is so common in β-convergence analysis, we will not regress growth rates on levels, but we will examine both the logged and the level form of the life expectancy and survival rate variables in the σ-convergence analysis.

σ-convergence analysis tests whether the spread of the distribution of a variable shrinks over time. The two concepts of convergence are similar, but not identical. β-convergence analysis examines whether past low performers fare better than past high performers and therefore analyses intra-distributional movement. As such it is a necessary condition for σ-convergence since the spread of the distribution could not shrink if the low performers did not catch up. It is not a sufficient condition, however, since theoretically the once poor performers could overtake the once strong performers to an extent that the spread of the distribution increases, which would result in β-convergence with simultaneous σ-divergence (Sala-i-Martin 1996). Further below we will see that for our variables of interest the analyses of β-convergence and σ-convergence produce very similar results.[6]

One way to test for σ-convergence is to look at the trend in the standard deviation. This works fine if the variables are kept in logged form since it is not sensitive to changes in the mean of the variable. It is more problematic if the variables are held in level form. Since mean life expectancies and infant and child survival rates are increasing over time, the standard deviation will increase if the distributional spread remained the same. Looking at the standard deviation of a mean-increasing variable in level form is therefore slightly biased against finding convergence. If, in order to avoid this problem, one were to look at the coefficient of variation (standard deviation divided by mean) instead, then the problem is that

this is approximately equal to the standard deviation of the natural logarithm of the variable (Sala-i-Martin 1995). It would therefore become a pointless exercise. In the estimations below we will see that there is very little difference in the convergence trends whether or not variables are held in log or level form. Hence any potential bias is too small to impact upon the analysis.

A further question is whether observations should be weighted or not. In the non-weighted case, Luxembourg counts the same as, say, China even though the latter has a much, much larger population size. To see whether weighting has any influence on our results, we perform all convergence analyses twice, namely once without and once with weighting by population size.

Results

Table 1 provides a β-convergence analysis of life expectancy in 186 countries in each decade from 1955 onwards. There is clear evidence for convergence in 1955-65, 1965-75 and 1975-85, respectively, as indicated by the negative and statistically significant β-coefficients of the log of the initial period value. Convergence then becomes stalled from 1985-95 onwards. Indeed, looked at over the period 1990 to 2005 there is actual divergence in life expectancies, as indicated by the positive and statistically significant coefficient. If observations are weighted by population size, then the picture is somewhat more optimistic. Convergence only becomes stalled in 1995 to 2005 (rather than already a decade before) and over the period 1990 to 2005 there is neither convergence nor divergence (rather than actual divergence as in the non-weighted regression). The reason is that India and China and a few other very populous developing countries do not currently have very high HIV/AIDS prevalence rates, do fairly well in terms of life expectancy improvements and dominate the weighted regressions due to their population size.

< Insert Table 1 about here >

In the 'No AIDS-scenario', all signs of lack of convergence or even divergence disappear. This follows from the fact that all β-coefficients are negative and statistically significant and holds true both for the non-weighted and the weighted regression analysis. In the absence of AIDS therefore, those countries with low life expectancies would continue catching up with those that have already high life expectancies. However, given the AIDS epidemic, there is no more global catching up and in some estimations the gap between the high and the low achievers is even widening.

An analysis of σ-convergence, provided in table 2, leads to similar results as the β-convergence analysis. This holds true whether we examine σ-convergence in the logged values of life expectancies or in levels. Divergence sets in from 1985 onwards in the non-weighted case and from 1995 onwards in the population-weighted case, as the respective standard deviations start to rise. Table 2 lists the standard deviation also of extrapolated life expectancies in the future. From this information we can discern that, in the non-weighted case, there is likely to be no convergence in the coming decade 2005 to 2015. After that, convergence can be expected again. Note, however, that the degree of inequality from 1985 – that is, before divergence set in – will only be achieved again after 2025. Only if we weigh observations by population size, can we expect convergence to set in already after 2005 and the degree of inequality from 1985 is achieved already after 2015. The reason is again that the most populous countries currently have relatively low HIV/AIDS prevalence rates. In the 'No AIDS-scenario', the standard deviations would be much lower and would continue falling over time instead of the (temporary) rise in the 'AIDS-scenario'. Confirming the

results from the β-convergence analysis, all signs of lack of convergence or even divergence disappear in the 'No AIDS-scenario'.

< Insert Table 2 about here >

Let us now turn to examining convergence in infant and child survival rates. Table 3 reports results for the β-convergence analysis. As can be seen, HIV/AIDS has not yet stalled the process of convergence that is taking place over the second half of the last century. The regression results from the 'No AIDS-scenario' show, however, that convergence would have been stronger in the last two decades without HIV/AIDS than it actually is. This follows from the fact that the β-coefficients in the 'No AIDS-scenario' are larger in size than their respective counterparts in the 'AIDS-scenario'. The σ-convergence analysis, for which results are presented in table 4, not only confirms the results from the β-convergence analysis, but also shows that convergence is not expected to become completely stalled or reverted to divergence at any point of time in the future.[7]

< Insert Tables 3 and 4 about here >

Of course, one should keep in mind that these results are based on estimations of the future and therefore carry a good deal of uncertainty with them. Bongaarts (1996) demonstrates the uncertainty involved in predicting the future course of the epidemic over as little as one decade. Future trends in prevention efforts, in access to antiretroviral treatment and in access to medical and care infrastructure are difficult to predict and will have important effects on the future trend in life expectancies and infant and child survival rates. Another problem with any scenario of life expectancy and infant and child survival rates that

is based on projections of the future is the great uncertainty about possible increases in infection rates outside the currently severely affected countries, the vast majority of which are located in Sub-Saharan Africa. Eberstadt (2002), for example, fears that we might see a tremendous increase in HIV/AIDS in Russia, China, India and other Asian countries. If this were to happen then the predicted convergence trend in the intermediate and far future might become stalled or even reversed.

Conclusion

The impact of HIV/AIDS on life expectancies and, if less pronounced, on infant and child survival in the most affected countries is simply horrendous. The tragedy in terms of loss of human health and life is difficult to do justice to in the words we use to describe the situation. In Botswana and Zimbabwe, for example, the current life expectancy at birth is already below 40 years and is expected to fall to 31.6 and 33 years, respectively, by 2010-15. These are extremely low values and put these two and similar most severely affected countries back to levels of life expectancy from before the Second World War or even the beginning of the 20th century. Botswana, which had one of the lowest child mortality rates in Sub-Saharan Africa, saw its success erode by the epidemic as mortality rates rose from 63 deaths in 1990-1995 to an estimated 104 deaths per 1000 births today (UNPD 2003, p. 10).

HIV/AIDS is not the only cause of a mortality crisis. Indeed, Eastern European countries and in particular those which belonged to the former Soviet Union experienced increased mortality during the economic and social crisis following the collapse of communism. External and violent causes of death together with diseases of the circulatory system account for the bulk of the mortality increase (Gavrilova et al. 2000). This comes on top of a trend already existent since the mid-1960s towards premature male mortality in many Eastern European countries (Watson 1995). However, in comparison to HIV/AIDS, the

impact on life expectancy at birth has been relatively modest. Even in Russia, one of the most severely affected countries, average life expectancy fell only slightly from 69.5 years to 66.1 years in the 1990s and is on the rise again. True, the average hides the fact that the impact is much stronger on males than on females and it is valid to speak of 'The Mortality Crisis in Transitional Economies' (Cornia and Paniccia 2000). But these tragic losses in life expectancy seem to have been reversed already and are simply dwarfed in terms of size by the much larger losses in life expectancy caused by HIV/AIDS in the severely affected countries. It is not the mortality crisis in the former Soviet Union that is 'without parallel in modern history', as Chen, Wittgenstein and McKeon (1996, p. 520) suggest, but the HIV/AIDS mortality crisis. Similarly, whilst mortality from violent crime is rising in many, particularly developing, countries, the effect on life expectancy of the general population rather than that of specific groups such as young black males living in ghettos, slums or *favelas* is generally negligible. For example, homicide contributes only about 0.6 years or 9.7 per cent to the life expectancy difference of 6 years between whites and blacks in the United States (Potter 2001).

This article has demonstrated that the losses of life expectancy due to HIV/AIDS have been the major cause of the recent lack of cross-national convergence and perhaps even divergence. The epidemic has not stalled convergence in infant and child survival rates, but it has slowed down the process of convergence. The fundamental reason why HIV/AIDS not only causes a mortality crisis in many countries, but also global divergence or a slow-down in convergence is due to two factors. First, the highest prevalence rates are found in countries faced with rampant poverty, low income levels and deficient health care systems. This implies higher mortality than if economically and socially developed countries experienced similar prevalence rates. Second, the epidemic is concentrated in countries that are low performers in life expectancy and infant and child survival rates. It thus prevents them from

catching up with the high performers, at least from catching up as fast as they would otherwise do. Once mortality due to HIV/AIDS is corrected for, the long-running trends toward convergence in these fundamental aspects of the quality of life are fully confirmed. But, of course, as a matter of fact HIV/AIDS exists and is here to stay with us.

That the epidemic has stalled cross-national convergence is rendered worse by the fact that convergence in fundamental aspects of the quality of life was cause for consolation to development scholars in the face of the well-established and disappointing lack of convergence or even divergence in average per capita income levels (Pritchett 1996, 1997; Quah 1996, 1997). The epidemic has taken away this consolation, at least for the time being. Worse still, it is likely to exacerbate existing divergence in per capita income levels. Early estimates predicted negligible impacts of the epidemic on per capita incomes in the most severely affected countries due to lower population growth compensating for the fall in economic output. However, newer estimates taking into account the increased speed and scale of the epidemic and the loss in human and social capital in addition to the loss in physical capital suggest a much larger impact (Bonnel 2000; Gaffeo 2003). This will lead to further divergence in per capita income levels. Dyson (2003) points toward the danger of a reversal of urbanization – a key component of economic development – as a result of higher urban to rural infection rates. In addition, the epidemic is also likely to exacerbate problems of poor governance in severely affected countries in Sub-Saharan Africa (De Waal 2003).

Another reason causing concern about the impact of HIV/AIDS on life expectancy at birth in particular is that life expectancy might be inter-linked with other measures of the quality of life. Kenny (2003, p. 20) suggests that ‘life expectancy is the best single proxy’ for a broad ‘basket’ of quality of life indicators. We know precious little about the inter-linkages among different aspects of the quality of life, but if they do exist then the lack of convergence

in life expectancy might cause lack of convergence in other aspects of the quality of life, possibly with a delay.

Fortunately, current projections imply that the lack of convergence or perhaps even divergence in life expectancy is only a temporary phenomenon. Riley (2001) shows that such temporal reverses have occurred in the past as well, for example, when the rapid increase in urbanization exceeded the infrastructure of cities to cope with urban population growth. One would hope that better and more equal access to medical care and treatment and hygienic conditions, more successful preventive measures and perhaps even the discovery of a vaccine will mitigate the loss in human life and the pain and suffering caused by HIV/AIDS, bringing the world back on the road towards convergence in these fundamental aspects of the quality of life.

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NOTES

[1] Although not the focus of this article, the same is true for many other aspects of the quality of life, for example, convergence in other health and educational indicators and in access to radio and television (Sab and Smith 2001; Neumayer 2003; Kenny 2003).

[2] Botswana, Cameroon, Central African Republic, Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe.

[3] With the exception of Brazil, India and Gambia, all countries in the UNPD list are also included in the U.S. Bureau of Census estimates. The list of countries included in UNPD estimates rose from 45 to 53 in the latest *World Population Prospects: The 2002 Revision*. However, the detailed data from this latest revision have not yet been fully released and could therefore not be used here.

[4] For the same reason, China, Russia and the United States are included in the *World Population Prospects: The 2002 Revision*.

[5] Note that the U.S. Bureau of Census reports infant mortality rates that are slightly different from those reported by the UN. Also, the total coverage of countries is not as comprehensive as in the UN database. For these reasons, we do not take their mortality rates directly, but use the estimated percentage difference in the two scenarios to calculate the 'No AIDS-scenario' for the infant mortality rates stemming from the UNPD.

[6] In principle, one could apply more sophisticated tools of convergence analysis as well such as Kernel density and Markov transition analysis (see Neumayer 2003). However, they are only really needed in very special cases, for example, if we are worried that countries permanently criss-cross from the upper to the lower bounds of a σ-converging distribution (Quah 1996) and this is not the case here.

[7] For reasons of space, we only report the standard deviations of the variables in logs since the respective results for the variables in level form are very similar.

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Appendix. Countries most severely affected by HIV/AIDS.

Countries included in UNPD estimations (UNPD 2001):

Angola, Bahamas, Benin, Botswana, Brazil, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Congo (Dem. Rep.), Congo (Rep.), Côte d'Ivoire, Djibouti, Dominican Republic, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea-Bissau, Guyana, Haiti, Honduras, India, Kenya, Lesotho, Liberia, Malawi, Mali, Mozambique, Myanmar, Namibia, Nigeria, Rwanda, Sierra Leone, South Africa, Swaziland, Tanzania, Thailand, Togo, Uganda, Zambia, Zimbabwe.

Countries included in U.S. Bureau of Census estimations (Way 2002):

Angola, Bahamas, Barbados, Belize, Benin, Botswana, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Congo (Dem. Rep.), Congo (Rep.), Côte d'Ivoire, Djibouti, Dominican Republic, Eritrea, Ethiopia, Gabon, Ghana, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Kenya, Lesotho, Liberia, Malawi, Mali, Mozambique, Myanmar, Namibia, Nigeria, Niger, Panama, Rwanda, Senegal, Sierra Leone, South Africa, Suriname, Swaziland, Tanzania, Thailand, Togo, Trinidad and Tobago, Uganda, Zambia, Zimbabwe.

TABLE 1

β-convergence analysis of life expectancy at birth.

	'AIDS-scenario'		'No AIDS-scenario'	
	non-weighted	population-weighted	non-weighted	population-weighted
1955-65	-.08***	-.19***		
	(8.48)	(5.85)		
1965-75	-.12***	-.23***		
	(11.58)	(3.66)		
1975-85	-.12***	-.15***		
	(6.94)	(6.84)		
1985-95	-.00	-.12***		
	(.06)	(2.90)		
1985-05	.04	-.14*	-.28***	-.30***
	(.81)	(1.87)	(6.99)	(7.14)
1990-05	.10**	-.02	-.16***	-.23***
	(2.38)	(.36)	(8.80)	(6.60)
1995-05	.02	.03	-.26***	-.21***
	(.80)	(.61)	(4.11)	(6.77)

Note: OLS regression of growth rate over period on log of initial level. N = 186. Absolute t-statistics in parentheses. Constant included, but coefficient not reported. Standard errors robust to heteroskedasticity. * significant at .1 level ** at .05 level *** at .01 level.

TABLE 2

σ-convergence analysis of life expectancy at birth.

	Logged form				Level form			
	'AIDS-scenario'		'No AIDS-scenario'		'AIDS-scenario'		'No AIDS-scenario'	
	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted
1955	.248	.244			12.17	12.46		
1965	.230	.198			12.06	10.95		
1975	.205	.167			11.27	9.54		
1985	.185	.145			10.64	8.69		
1995	.198	.137			11.18	8.24		
2005	.226	.157	.154	.115	12.84	9.28	9.57	7.34
2015	.226	.153	.132	.102	12.88	9.21	8.61	6.77
2025	.201	.137			11.93	8.57		
2035	.170	.117			10.59	7.69		
2045	.144	.100			9.37	6.84		
2050	.133	.093	.069	.061	8.83	6.46	5.12	4.53

Note: Reported values are standard deviations. N = 186.

TABLE 3

β-convergence analysis of infant and child survival rates.

	Infant survival				Child survival			
	'AIDS-scenario'		'No AIDS-scenario'		'AIDS-scenario'		'No AIDS-scenario'	
	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted
1960-70	-.12***	-.33**			-.17***	-.26***		
	(8.19)	(2.40)			(6.72)	(3.37)		
1970-80	-.13***	-.12***			-.19***	-.16***		
	(6.74)	(3.11)			(9.10)	(4.04)		
1980-90	-.20***	-.27***			-.12***	-.21***		
	(3.40)	(6.81)			(5.18)	(5.26)		
1980-00	-.29***	-.41***	-.33***	-.43***	-.23***	-.37***	-.28***	-.40***
	(4.91)	(8.70)	(5.95)	(10.34)	(6.40)	(6.40)	(7.75)	(8.13)
1990-00	-.09***	-.15***	-.14***	-.19***	-.10***	-.15***	-.16***	-.20***
	(4.19)	(4.77)	(6.30)	(7.23)	(4.16)	(4.17)	(6.48)	(6.96)

Note: OLS regression of growth rate over period on log of initial level. N = 186 for infant and N = 158 for child survival rates. Absolute t-statistics in parentheses. Constant included, but coefficient not reported. Standard errors robust to heteroskedasticity. * significant at .1 level ** at .05 level *** at .01 level.

TABLE 4

σ-convergence analysis of infant and child survival rates (logged).

	Infant survival				Child survival			
	'AIDS-scenario'		'No AIDS-scenario'		'AIDS-scenario'		'No AIDS-scenario'	
	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted
1960	.066	.071			.131	.109		
1970	.060	.055			.112	.087		
1980	.056	.050			.094	0.076		
1990	.047	.038			.085	.062		
2000	.044	.034	.042	.033	.079	.057	.073	.053
2010	.037	.029	.034	.027	.069	.050		
2020	.031	.024			.056	.042	.050	.038
2030	.024	.020			.043	.034		
2040	.019	.016			.032	.027		
2050	.015	.013			.024	.020		

Note: Reported values are standard deviations. N = 186 for infant and N = 158 for child survival rates.