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HIV/AIDS and cross-national convergence in life expectancy

FINAL VERSION

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HIV/AIDS and cross-national convergence in life expectancy

This article analyzes the impact of HIV/AIDS on the cross-national convergence in life expectancy as well as infant and child survival rates by comparing three scenarios. One is based on historical and future best guess estimated values given the existence of the epidemic. The second scenario assumes that the effect of the epidemic is much worse than expected. The final scenario is based on hypothetical values derived from estimations where the mortality caused by the epidemic is taken out. For life expectancy, convergence 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. These results are mainly due to the epidemic since all signs of stalled convergence or even divergence disappear in the 'No AIDS-scenario'. Given the existence of the epidemic, however, the degree of inequality in life expectancy is only expected to be achieved again no earlier than 2015. If the epidemic turns out much worse than expected, there could be continuing divergence to 2050. No divergence is to be expected in infant and child survival rates in any of the scenarios.

Introduction

For the most part of the last century there has been cross-national convergence in life expectancy and infant and child survival rates. Life expectancy and survival rates 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), Ram (2003) and Goesling and Firebaugh (2004) are exceptions to this neglect. Wilson (2001, p. 167) merely notes that ‘between 1975-80 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’. Goesling and Firebaugh (2004) also demonstrate divergence in the 1990s, attributing it largely to the effect of HIV/AIDS. 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 three scenarios: a 'Historical and Expected AIDS-scenario', a 'High AIDS-scenario' and a 'No AIDS-scenario'. The first scenario is one of estimated historical and future best guess survival rates and life expectancies. The 'High AIDS-scenario' assumes that the epidemic has far worse consequences in high prevalence countries than expected. Whereas the 'No AIDS-scenario' is based on survival rates and life expectancies taking out the estimated best guess 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 in the 'Historical and Expected AIDS-scenario' and until the end of our period of analysis (2050) in the 'High AIDS-scenario'. The epidemic has not led to divergence in infant or child survival rates and will not do so in the future in any of the scenarios, but it has slightly 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 three 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). Also, by far not all women transmit the virus to their babies. 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.

Three AIDS-scenarios

We will analyze trends in convergence in life expectancy and survival rates according to three different scenarios. The first scenario, the ‘Historical and Expected AIDS-scenario’ is based on estimates of best guess observed past and current values of survival rates and life expectancies as well as their extrapolations into the future via best guess estimates.

The second scenario, the ‘High AIDS-scenario’, takes account of the fact that the AIDS-epidemic might turn out to have much worse effects than expected. There are many possible ways such a ‘High AIDS-scenario’ could be modeled. One possibility is that countries with currently low HIV/AIDS prevalence could turn into countries with high prevalence. There is 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. However, this is very speculative. Instead, we will simply assume here that the list of countries with high prevalence remains the same, but that the effects on life expectancies and survival rates are worse than expected and increasingly so the further in the future the best guess estimate lies. Specifically, we will assume that life expectancies in high prevalence countries in 2005 are over-estimated in the best guess estimates and are 5 per cent below the 'Historical and Expected AIDS-scenario', rising linearly to 25 per cent below in 2050. For infant and child mortality rates, given that the effect of HIV/AIDS on infant and child mortality is less pronounced than the effect on life expectancies, we will assume that mortality rates are also under-estimated in the best guess estimates, but are only 2.5 per cent above the 'Historical and Expected AIDS-scenario' in 2000, rising linearly to 12.5 per cent in 2050.

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.³ 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 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 best guess estimations into the future until 2050. It should be noted that both historical data as well as, even more so, the best guess future estimations are potentially subject to measurement error and have to be treated with some caution. The data are compiled and distributed by the same source used here, namely the United Nations Common Statistical Database (UN 2003). They form the basis for the ‘Historical and Expected AIDS-

scenario' and, with the modifications stated above, for the 'High AIDS-scenario' as well. For the 'No AIDS-scenario', UNPD (2001) provides estimates for the under-5 mortality rate in 2000 and 2020 and UNPD (2003) for life expectancies in the years 2005, 2015 and 2050. Results for infant mortality are very similar to results for the under-5 mortality, such that we report results only for the latter. 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 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 analyzes 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.⁵

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 our case, it makes very little difference whether or not variables are held in log or level form for the convergence trends. Hence any potential bias is too small to impact upon the analysis here and we report results from trends in the standard deviation of variables held in level form only.

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.⁶ 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. This remains true if we look at the change in life expectancy up to the current period (i.e., 2005). To explore this issue further we also look at different time spans than the 10-year period now. For the ‘Historical and Expected AIDS-scenario’, there is actual divergence in life expectancies over the period 1990 to 2005, 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 ‘High AIDS-scenario’, the situation is bleaker than in the ‘Historical and Expected AIDS-scenario’. There is actual divergence over the periods 1985 to 2005 and 1990 to 2005. As before, the picture is somewhat more optimistic if observations are weighted by population size, with divergence setting in only in the period 1995 to 2005. 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. We merely present results from analyzing σ -convergence in the level values of life expectancies as the analysis in logs leads to practically identical conclusions. 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. In the ‘Historical and Expected AIDS-scenario’, there is likely to be no convergence in the coming decade

2005 to 2015 in the non-weighted case. 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.

< Insert Table 2 about here >

In the ‘High AIDS-scenario’, there is divergence over the whole period in the weighted case and divergence with the exception of a brief intermezzo between 2025 and 2035 in the non-weighted case. Clearly, if the AIDS-epidemic turns out to be much worse than expected, this could mean the end of convergence in life expectancies for many decades to come. For the ‘No AIDS-scenario’, we have unfortunately only data for three periods of time: 2005, 2015 and 2050. Compared to the ‘Historical and Expected AIDS-scenario’, the standard deviations are much lower and would continue falling over time instead of the (temporary) rise. Confirming the results from the β -convergence analysis, all signs of lack of convergence or even divergence disappear in the ‘No AIDS-scenario’. For better illustration, figure 1 plots the trend in standard deviation for the three scenarios in the non-weighted case.

< Insert Figure 1 about here >

Let us now turn to examining convergence in child survival rates. As mentioned above, the analysis of convergence in infant survival rates leads to very similar results. 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 in the ‘Historical and Expected AIDS-scenario’. 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’. In the ‘High AIDS-scenario’, convergence is less pronounced than in the ‘Historical and Expected AIDS-scenario’, but still prevails since the respective coefficients are smaller in size, but all negatively signed and statistically significantly different from zero.

< Insert Table 3 about here >

Results for the σ -convergence analysis in levels are presented in table 4. Results for the analysis in logs are again very similar and therefore not reported. In the ‘Historical and Expected AIDS-scenario’, convergence is not expected to become completely stalled or reverted to divergence at any point of time in the future, whether or not observations are weighted by population size. The same is true for the ‘No AIDS-scenario’, but here convergence is much more pronounced. Note that, unfortunately, for this scenario there are estimates from only two time periods available, namely 2000 and 2020. Even in the ‘High AIDS-scenario’, convergence does not become stalled at any point of time.

< Insert Table 4 about here >

Discussion and 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 other 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. 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 Panizza 2000). But these tragic losses in life expectancy 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. That the epidemic has stalled cross-national convergence in life expectancy 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 (Bonnell 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.

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.

Fortunately, current projections imply that the lack of convergence or perhaps even divergence in life expectancy is only a temporary phenomenon as the results from our ‘Historical and Expected AIDS-scenario’ suggest. 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. If, on the other hand, the epidemic has a much worse impact on life expectancies and child survival rates than expected, then it could take many decades still until convergence in life expectancy is achieved again. Our ‘High AIDS-scenario’, which by necessity cannot be more than a crude modeling of a far more severe epidemic than expected, suggests that given our

assumptions there would be divergence in life expectancies over the course of the next 45 years. With respect to infant and child survival rates, the converging trend is so strong, however, that even in this scenario it does not come to a halt.

Which scenario is more likely to happen in the future is very difficult to say. 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. 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, thus bringing the world back on the road towards convergence in these fundamental aspects of the quality of life quicker than predicted by the 'Historical and Expected AIDS-scenario'.

Acknowledgement

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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 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 had not yet been fully released at the time of writing 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 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.

⁶ Note that because the UN provides data in five-year averages, the regressions report results on the growth rate between 1955-60 and 1960-65 against the life expectancy in 1955-60 and so on.

References

- Becker, Gary S., Tomas J. Philipson, and Rodrigo R. Soares. 2003. "The Quantity and Quality of Life and the Evolution of World Inequality." Working Paper 9765, Cambridge, MA: National Bureau of Economic Research.
- Bongaarts, John. 1996. "Global Trends in AIDS Mortality." *Population and Development Review* 22 (1): 21-45.
- Bonnell, B. 2000. "HIV/AIDS and Economic Growth: A Global Perspective." *South African Journal of Economics* 68 (December): 820-55.
- Caldwell, John C. 2000. "Rethinking the African AIDS Epidemic." *Population and Development Review* 26 (March): 117-135.
- Chen, Lincoln C., Friedericke Wittgenstein, and Elizabeth McKeon. 1996. "The Upsurge of Mortality in Russia: Causes and Policy Implications." *Population and Development Review* 22 (3): 517-30.
- Cornia, Giovanni Andrea, and Renato Panicià. 2000. *The Mortality Crisis in Transitional Economies*. Oxford: Oxford University Press.
- De Waal, Alex. 2003. "How Will HIV/AIDS Transform African Governance?." *African Affairs* 102: 1-23.
- Dyson, Tim. 2003. "HIV/AIDS and Urbanization." *Population and Development Review* 29 (3): 427-442.
- Easterlin, Richard A. 2000. "The Worldwide Standard of Living Since 1800." *Journal of Economic Perspectives* 14 (Winter): 7-26.
- Eberstadt, Nicholas. 2002. "The Future of AIDS." *Foreign Affairs* 81 (November/December): 22-45.
- Gaffeo, Edoardo. 2003. "The Economics of HIV/AIDS: A Survey." *Development Policy Review* 21: 27-49.

- Gavrilova, Natalia S., Victoria G. Semyonova, Galina N. Evdokushkina, and Leonid A. Gavrilov. 2000. "The Response of Violent Mortality to Economic Crisis in Russia." *Population Research and Policy Review* 19: 397-419.
- Goesling, Brian, and Glenn Firebaugh. 2004. "The Trend in International Health Inequality," *Population and Development Review* 30 (1): 131-146.
- Hobijn, Bart, and Philip Hans Franses. 2001. "Are Living Standards Converging?." *Structural Change and Economic Dynamics* 12: 171–200.
- Ingram, Gregory K. 1994. "Social Indicators and Productivity Convergence in Developing Countries." In *Convergence of Productivity – Cross-National Studies and Historical Evidence*, eds. Baumol, W.J., Nelson, R.R., Wolff, E.N. New York: Oxford University Press.
- Kenny, Charles. 2003. "Why are We Worried About Income? Everything that Matters is Converging." Working paper, Washington, DC: World Bank.
- Mazumdar, Krishna. 2003. "Do Standards of Living Converge? A Cross-country Study." *Social Indicators Research* 64: 29-50.
- Neumayer, Eric. 2003. "Beyond Income: Convergence in Living Standards, Big Time." *Structural Change and Economic Dynamics* 14: 275-296.
- Philipson, Tomas, and Richard A. Posner. 1995. "The Microeconomics of the AIDS Epidemic in Africa." *Population and Development Review* 21 (4): 835-848.
- Potter, L. 2001. "Influence of Homicide on Racial Disparity in Life Expectancy – United States, 1998." *Morbidity and Mortality Weekly Report* 50 (14 September): 780-3.
- Pritchett, Lant. 1996. "Forget Convergence: Divergence Past, Present, and Future." *Finance & Development*: 40–43.
- Pritchett, Lant. 1997. "Divergence, Big Time." *Journal of Economic Perspectives* 11: 3–17.

- Quah, Danny T. 1996. "Empirics for Economic Growth and Convergence." *European Economic Review* 40: 1353-1375.
- Quah, Danny T. 1997. "Empirics for Growth and Distribution: Stratification, Polarization, and Convergence Clubs." *Journal of Economic Growth* 2: 27-59.
- Ram, Rati. 1982. "International Inequality in the Basic Needs Indicators." *Journal of Development Economics* 10: 113-7
- Ram, Rati. 1998. "Forty Years of the Life Span Revolution: An Exploration of the Roles of "Convergence," Income, and Policy." *Economic Development and Cultural Change* 46: 849-857.
- Ram, Rati. 2003. "State of the "Life Span Revolution" Between 1980 and 2000." Working paper, Illinois State University.
- Ram, Rati and Theodore W. Schultz. 1979. "Life Span, Health, Savings, and Productivity." *Economic Development and Cultural Change* 27: 399-421.
- Riley, James C. 2001. *Rising Life Expectancy: A Global History*. New York: Cambridge University Press.
- Sab, Randa, and Stephen C. Smith. 2001. "Human Capital Convergence: International Evidence." Working Paper WP/01/32, Washington, DC: International Monetary Fund.
- Sala-i-Martin, Xavier X. 1995. "The Classical Approach to Convergence Analysis." Discussion Paper No. 1254, London, Centre for Economic Policy Research.
- Sala-i-Martin, Xavier X. 1996. "The Classical Approach to Convergence Analysis." *Economic Journal* 106: 1019-1036.
- Theil, Henri. 1979. "World Income Inequality and its Components." *Economics Letters* 2: 99-102.
- UN. 2003. *Statistics Division Common Database*. New York: United Nations.

- UNAIDS. 2003. *AIDS Epidemic Update*. Geneva: Joint United Nations Programme on HIV/AIDS and World Health Organization.
- UNPD. 2000. *World Population Prospects: The 1998 Revision*. New York: United Nations.
- UNPD. 2001. *World Population Prospects: The 2000 Revision. Volume III: Analytical Report*. New York: United Nations.
- UNPD. 2003. *The Impact of HIV/AIDS on Mortality*. UN/POP/MORT/2003/14. New York: United Nations Secretariat Population Division.
- USAID and U.S. Department of Commerce. 1999. *World Population Profile: 1998 – With a Special Chapter Focusing on HIV/AIDS in the Developing World*. Washington, DC: U.S. Agency for International Development and U.S. Department of Commerce, Bureau of the Census.
- Watson, Peggy. 1995. “Explaining Rising Mortality Among Men in Eastern Europe.” *Social Science & Medicine* 41: 923-34.
- Way, Peter O. 2003. *The Future of Adult Mortality under the AIDS Threat: Estimating and Projecting Incidence; Projecting Mortality with HIV/AIDS*. UN/POP/MORT/2003/11. New York: United Nations Secretariat Population Division.
- Wilson, Chris. 2001. “On the Scale of Global Demographic Convergence 1950-2000.” *Population and Development Review* 27 (March): 155-171.

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.

TABLE 1

Results from OLS regression of growth rate in life expectancy at birth on initial period logged levels.

	‘Historical and Expected AIDS-scenario’		‘High AIDS-scenario’		‘No AIDS-scenario’	
	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted
1955-65	-.08*** (8.48)	-.19*** (5.85)				
1965-75	-.12*** (11.58)	-.23*** (3.66)				
1975-85	-.12*** (6.94)	-.15*** (6.84)				
1985-95	-.00 (.06)	-.12*** (2.90)				
1985-05	.04 (.81)	-.14* (1.87)	.11** (2.14)	-.98 (.98)	-.28*** (6.99)	-.30*** (7.14)
1990-05	.10** (2.38)	-.02 (.36)	.18*** (3.68)	.04 (.49)	-.16*** (8.80)	-.23*** (6.60)
1995-05	.02 (.80)	.03 (.61)	.09 (1.11)	.10* (1.70)	-.26*** (4.11)	-.21*** (6.77)

Note: 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

Standard deviations of life expectancy at birth (N = 186).

	‘Historical and Expected AIDS-scenario’		‘High AIDS-scenario’		‘No AIDS-scenario’	
	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted
1955	12.17	12.46				
1965	12.06	10.95				
1975	11.27	9.54				
1985	10.64	8.69				
1995	11.18	8.24				
2005	12.84	9.28	13.55	9.82	9.57	7.34
2015	12.88	9.21	14.24	10.32	8.61	6.77
2025	11.93	8.57	14.30	10.57		
2035	10.59	7.69	14.03	10.69		
2045	9.37	6.84	14.23	11.27		
2050	8.83	6.46	14.35	11.57	5.12	4.53

TABLE 3

Results from OLS regression of growth rate in child survival rates on initial period logged levels.

	‘Historical and Expected AIDS-scenario’		‘High AIDS-scenario’		‘No AIDS-scenario’	
	non-weighted	population-weighted	non-weighted	population-weighted	non-weighted	population-weighted
1960-70	-.17*** (6.72)	-.26*** (3.37)				
1970-80	-.19*** (9.10)	-.16*** (4.04)				
1980-90	-.12*** (5.18)	-.21*** (5.26)				
1980-00	-.23*** (6.40)	-.37*** (6.40)	-.21*** (5.72)	-.36*** (5.94)	-.28*** (7.75)	-.40*** (8.13)
1990-00	-.10*** (4.16)	-.15*** (4.17)	-.08*** (3.15)	-.14*** (3.44)	-.16*** (6.48)	-.20*** (6.96)

Note: N = 158. 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

Standard deviations of child survival rates (N = 158).

	‘Historical and Expected AIDS-scenario’		‘High AIDS-scenario’		‘No AIDS-scenario’	
	non-weighted	non-weighted	population-weighted	population-weighted	non-weighted	population-weighted
1960	104.48	91.52				
1970	93.55	74.80				
1980	80.95	66.77				
1990	74.19	55.52				
2000	69.92	51.23	71.32	52.14	65.12	48.01
2010	62.09	45.32	64.39	46.83		
2020	50.84	38.21	53.61	40.13	45.82	34.89
2030	39.98	31.22	42.87	33.28		
2040	30.51	24.80	33.30	26.81		
2050	22.91	19.18	25.50	21.03		

Figure 1. Trend in standard deviation of life expectancy (non-weighted case).

