

## CHAPTER 3 *Demographic Forecast under the HIV/AIDS Epidemic*

**U**nderlying economic and demographic conditions determine the impact of the HIV/AIDS epidemic. In Ukraine, the epidemic exacerbates negative demographic trends with adverse depopulation and eroding health.

The current demographic trend in Ukraine is characterized by massive depopulation through reduced fertility, increased mortality, and out-migration. The current fertility rate of 1.1-1.2 births per woman is just a half of the replacement level rate of 2.2 (IDSS 2005). The number of births dropped over 1991-2003, from 630,800 to 408,600. With deaths exceeding births by a factor of two, Ukraine's population decreases by more than 300,000 persons per year. Natural depopulation was 3.9 million in 1991-2003, a trend projected to continue (Derzhkomstat 2005). Ukraine's reduction of population size is not unique. Many European countries face similar birth rate declines, but Ukrainian depopulation is among the fastest in the world and, unlike in developed countries, is accompanied by deterioration of health status, increased mortality, and reduced life expectancy. Worsening health status is more common among males due to noncommunicable diseases, mental illness, stress, and alcohol-related accidents and injuries (Brainerd and Culter 2005).

Poor health status has resulted in increased mortality in practically all age groups except children. The most significant losses are among those of working age. High mortality in this group is the main reason for low life expectancy in Ukraine. On average, male (female) life expectancy is 11-12 (7-8) years less than in developed European countries. Life expectancy at birth in 2003 was 62.3 years for males and 73.5 for females. Improving health status and life expectancy

could counter negative demographic pressures and reduce the epidemic's impact.

Reductions in life expectancy reflect the hardships of transition. Difficult socioeconomic conditions, a decline in living standards, and a sharp reduction in income in the last decade and a half all negatively affected demographics. From 1990 to 1998 Ukraine experienced a 60 percent fall in GDP. Additional impacts of the HIV epidemic on Ukrainian demographics are examined in the following sections.

### **Analysis at the National Level**

This study constructed a baseline "no-AIDS" demographic projection of the Ukrainian population until 2014 and added three HIV/AIDS epidemic scenarios (optimistic, medium, and pessimistic). The projection period is 1994-2014. These scenarios differ in their assumptions about the size and dynamics of the most-at-risk populations, yielding different estimates of adult prevalence rates. In the optimistic scenario the adult HIV prevalence rate peaks at 2 percent in 2010; it peaks at 2.48 percent in 2009-10 in the medium scenario; and it rises continuously reaching 3.5 percent in 2014 in the pessimistic scenario. Reduction in the MTCT rate (15.9 percent in 2003) is faster in the optimistic scenario (to 10 percent in 2004 and then to 5 percent in 2014) than in the medium (gradual reduction to 5 percent by 2014) and pessimistic (gradual reduction to 10 percent in 2014) scenarios. Availability of ART to those who need it increases from 1 percent in 2004 to 30 percent in 2010 and further to 50 percent in 2014 in the optimistic scenario; to 5 percent in 2005, to 10 percent by 2010, and remaining there until 2014 in the medium one; and to 5 percent in 2005 and remaining

there until 2014 in the pessimistic one. The study also constructed three cost scenarios (referred to as A, B, and C) for ART. Details of the modeling methodology and assumptions are in Annex 2.<sup>5</sup>

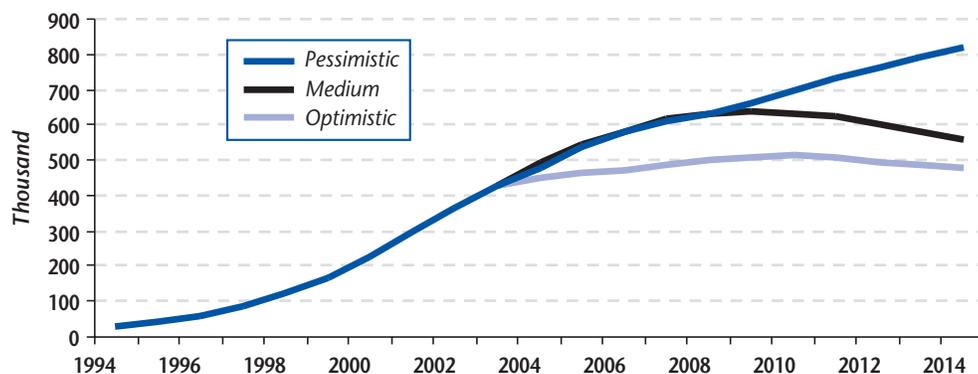
### **HIV/AIDS Epidemic Projections: Major Findings**

In the medium epidemic scenario, the study projects about 477,000 Ukrainian adults were living with HIV/AIDS in 2004 (range: 448,000-491,000), which corresponds to an adult prevalence rate of 1.8 percent (range: 1.7-1.9 percent). In this scenario, the total number of infections will peak at 640,700 in 2009; by 2014, the total will range from 478,500 to 820,400 (optimistic-pessimistic).<sup>6</sup> Figure 3-1 presents these data graphically while Annex 2 Tables A2-1 and A2-2 provide more detailed forecast results.

Based on the forecast, the importance of AIDS as a cause of death will increase, especially for younger age groups. The share of AIDS deaths among total deaths in Ukraine in 2004 was 2.3 percent. In the optimistic, medium, and pessimistic forecasts, it is projected to grow by 2014 to 4.8 percent, 7.9 percent, and 8.6 percent, respectively (Figure 3-2 on page 12).

HIV's spread leads to growth in premature deaths, disability, co-infection of opportunistic diseases and TB, and reduction in life expectancy. The risk of falling sick and dying of AIDS varies by age and sex. First, AIDS victims are mainly young people, so the most significant changes will occur in the structure of mortality of the working- and childbearing-age population. In particular, the share of AIDS-caused deaths among total number of deaths in the 15-49 age group will increase from 13.2 percent in 2004 to 41.4 percent in 2014 (Figure 3-3 on page 12). AIDS will gradually become the leading cause of death among younger adults. This will deplete the young and productive population, with people aged 30-39 suffering the most.

**Figure 3-1. Forecasted Number of Those Infected with HIV, 1994-2014**



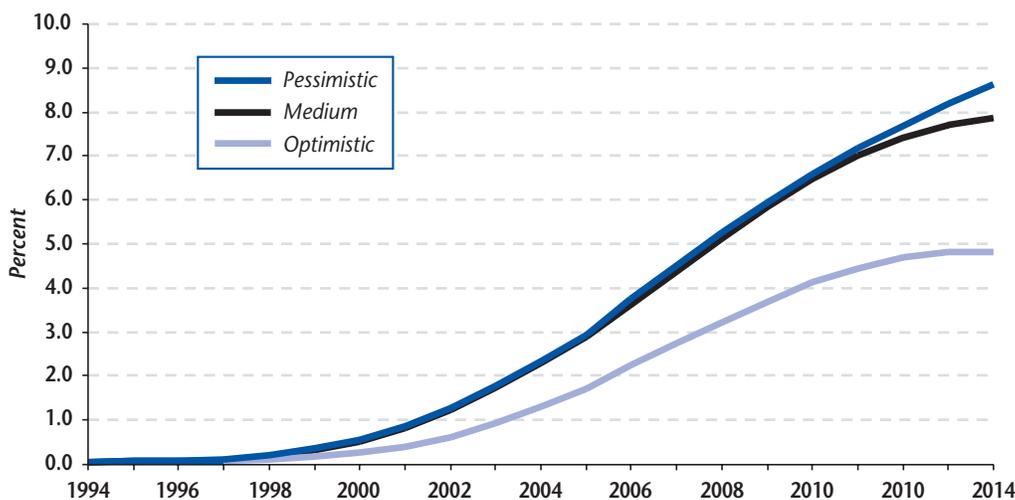
Source: Authors' calculations.

Second, despite the fact that most of those infected with HIV or dying from AIDS are males, the share of females among the infected will grow under all three scenarios. In the medium scenario, the share of AIDS deaths in all adults (15-49) will increase by a factor of 2.7 for males and 3.5 for females during 2004-14. In 2014, about a third (32.3 percent) of all deaths in adult males and almost two-thirds of all deaths in adult females will be caused by AIDS (Figure 3-3). These predictions reflect our modeling assumptions about rising female HIV transmission rates, based on the infection pattern observed in 1995-2004. While HIV/AIDS is contributing to extremely high mortality rates in young and middle-age Ukrainian men, the relative importance of AIDS as a cause of death is more significant for females. Consequently, the epi-

<sup>5</sup> This study's methodology for projecting HIV/AIDS dynamics is based on Schwartlander et al. (1999), UNAIDS (2002), etc. The internationally used method of back-projection (Becker, Watson, and Carlin [1991], Becker and Motika [1993], Becker and Marschner [1993], Becker and Egerton [1994], etc.) for estimating unobserved past incidence of HIV infection and to predict future AIDS incidence is of limited applicability to countries with poor AIDS incidence data.

<sup>6</sup> Comparing our findings with those of Barnett et al. (BW): the BW adult prevalence rate estimate for 2005 was 1.47 percent in the optimistic and 2.92 percent in pessimistic scenarios. Our optimistic adult prevalence rate of 1.76 percent in 2005 is higher than BW's optimistic, while our pessimistic estimate of 2.09 percent is lower than their pessimistic estimate: the band for our estimates is narrower. BW's predicted adult prevalence rates for 2010 are 1.97 percent in the optimistic and 4.91 percent in pessimistic scenarios. The difference in outcomes results from the difference in inputs into the Spectrum model as new evidence has become available.

**Figure 3-2. Forecasted Share of AIDS Deaths in Total Number of Deaths, 1994-2004**



Source: Authors' calculations.

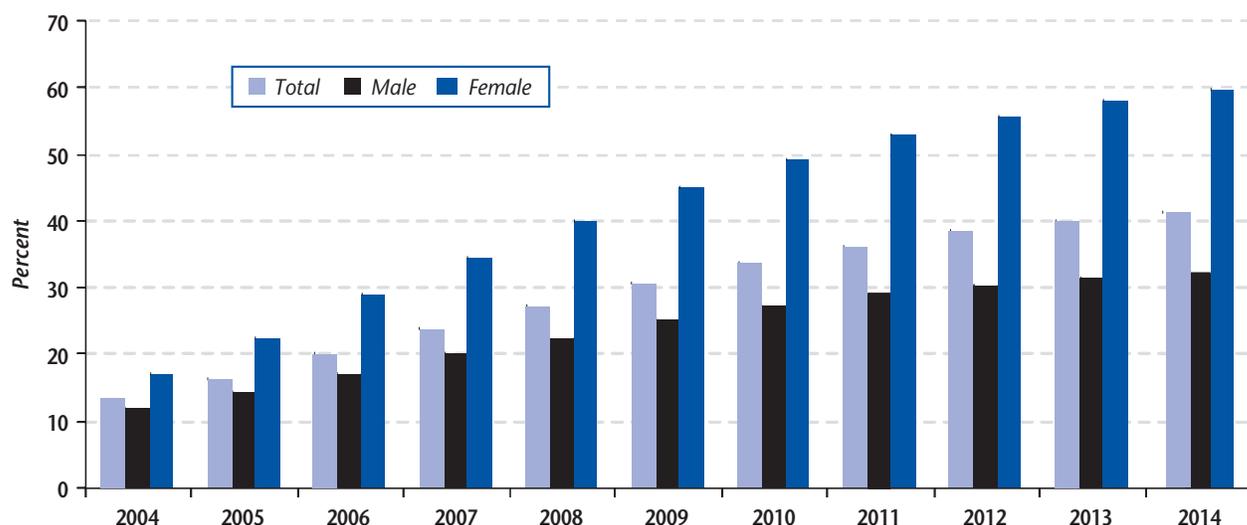
demic's impact is likely to be more striking among females. AIDS may become the leading cause of deaths in females aged 15-49 by 2010.

The modelling results suggest that the hardest hit are young and female. The estimated HIV incidence rate for adults aged 15-49 in 2004 was 0.25 percent, with the highest incidence rate of 0.69 percent in the 20-

24 age group. Two-thirds of all new HIV infections are among young people aged 20-34, and 39 percent of the newly infected are women, according to the 2004 medium scenario. Young women are more vulnerable than young men: the incidence rate for women 20-24 is 0.88 percent and 0.5 percent for men of the same age. By 2014, the 20-34 age group is estimated to account for three-quarters of all new HIV infections, half of which will be among women. This evidence mimics the finding on other STIs (Mavrov and Bondarenko 2002), where the ratio of female to male infections is 5:1 among those aged 15-17 and more than 2:1 for those 18-20.

The medium scenario indicates that the peak in annual AIDS deaths (59,000) will occur in 2014 because that is the final year of the model forecast with accumulated AIDS deaths exceeding half a million (510,900). Whether AIDS mortality will continue

**Figure 3-3. Forecasted Share of AIDS Deaths in Total Adult (15-49) Deaths, 2004-2014**



Source: Authors' calculations.

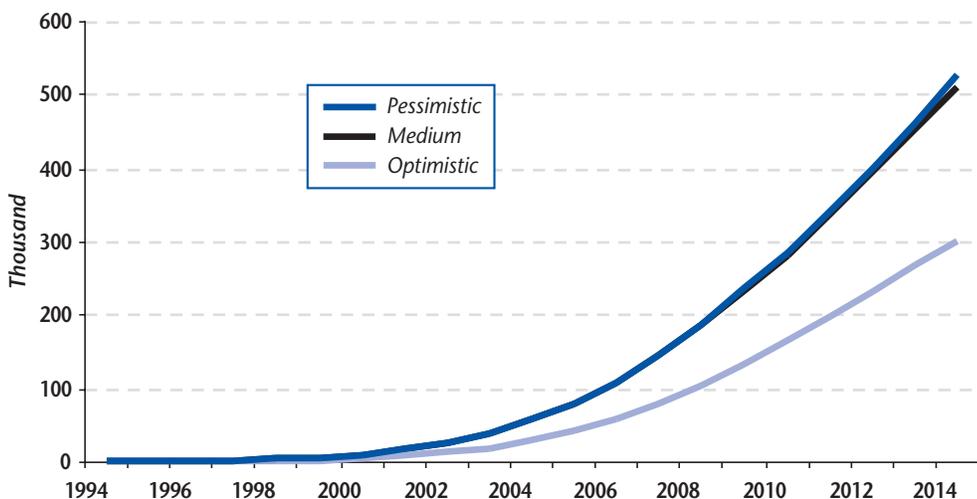
to rise beyond the study forecast horizon will depend on whether the epidemic is curbed. In the optimistic scenario, which assumes a slow progression from HIV infection to AIDS, more reduction of MTCT, and better access to ART, the cumulative number of AIDS deaths is well below half a million: 301,300. In the pessimistic scenario, the number is 526,400 (Figure 3-4). The peak in the annual AIDS deaths among children occurs in 2007 and equals 721 under the medium scenario, and 525 under the optimistic one. The pessimistic scenario predicts AIDS childhood deaths will grow continuously, reaching 960 in 2014.

### HIV/AIDS Impact on Life Expectancy

The spread of HIV/AIDS and the related increase in mortality will have a negative impact on life expectancy in Ukraine. The maximum reduction in total life expectancy resulting from the epidemic will be observed in the year of the highest AIDS mortality, 2014. It is assumed that in the absence of AIDS, life expectancy would increase by the end of forecast period to 65.6 years for males and 75.8 years for females, but the epidemic will likely bring life expectancy down to 61.6-63.4 for males and to 71.0-72.9 for females, depending on the scenario. This equals a reduction of 3.2-4 years for males and 2.9-4.8 years for females (Figure 3-5).

The demographic forecast indicates that the Ukrainian population would continue

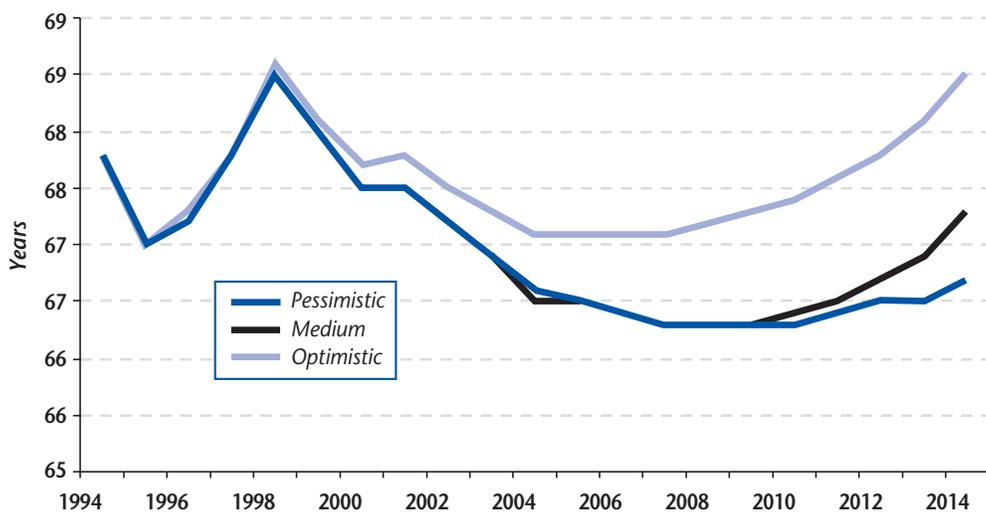
**Figure 3-4. Forecasted Accumulated AIDS Deaths, 1994-2014**



Source: Authors' calculations.

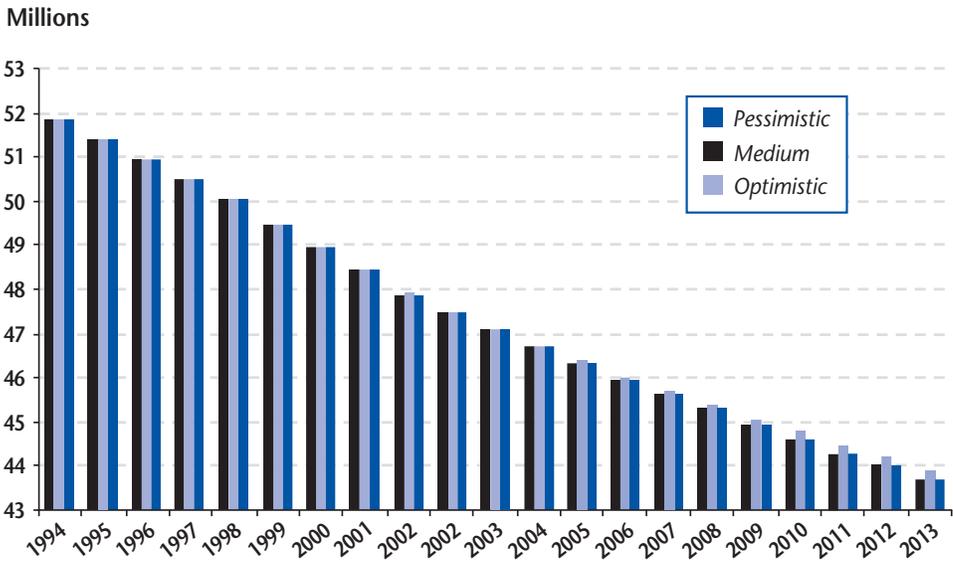
to shrink even without HIV/AIDS. Under the assumptions of the “no-AIDS” scenario, the population would be 44.2 million in 2014, a reduction of 7.6 million from 51.8 million in 1994, the projection’s baseline. The AIDS epidemic will accelerate depopulation, likely causing an additional decrease of 0.3-0.5 million, leaving 43.7 million-43.9 million in total population (Figure 3-6 on page 14).

**Figure 3-5. Forecasted Life Expectancy at Birth, 1994-2014, in Years**



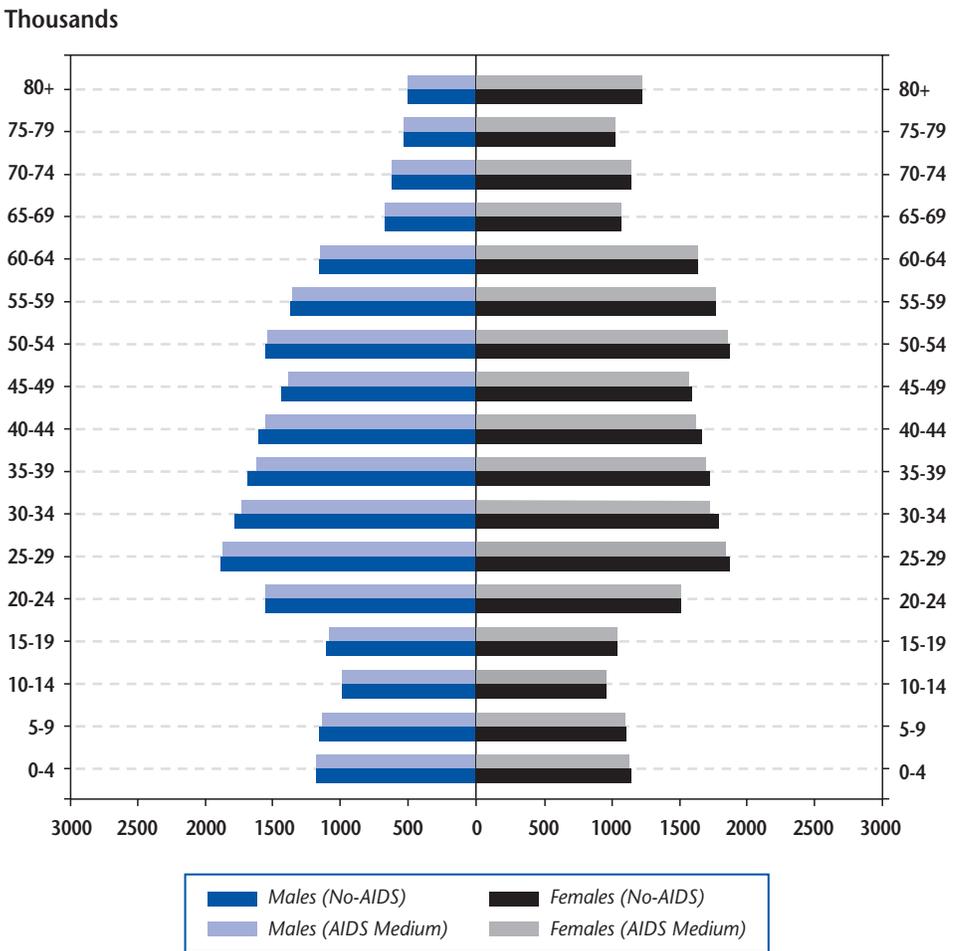
Source: Authors' calculations.

**Figure 3-6. Forecasted Total Population, 1994-2014**



Source: Authors' calculations.

**Figure 3-7. Age-Gender Composition of Population, "No-AIDS" and "AIDS Medium" Scenarios, 2014**



Source: Authors' calculations.

The interaction between Ukraine's epidemic and age dynamics and their combined effect are ambiguous. On one hand, younger people infected with HIV will withdraw from the labor force at some stage, increasing work load on the remaining working population. The adults aged 15-59 are estimated to total 28.4 million in the "no-AIDS" scenario, but this figure drops 300,000-500,000 depending on the scenario: the total is 28.1 million in the optimistic and 27.9 million in the pessimistic scenarios. The largest losses are incurred by those 30-39 and are expected to become particularly acute in 2010 when negative demographic trends and population aging accelerate and the working-age group shrinks even further. In particular, in the "no-AIDS" scenario, the proportion of people 60 years and older in the total population will increase from 20.9 percent in 2004 to 21.3 percent in 2014. With AIDS, it will reach 21.5 percent at the end of the forecast period (Figure 3-7).

On the other hand, the size of the 20-30 age group and this group's relative share in the total population are both predicted to fall after 2010, when the baby-boom effect of the early 1980s runs out. The number of people susceptible to HIV—younger age groups—will decline. HIV prevalence may reduce or remain the same. Further spread of the epidemic is possible if the infection generalizes and is no longer contained within the higher-risk groups. In such case the entire population becomes at-risk, and the epidemic's potential

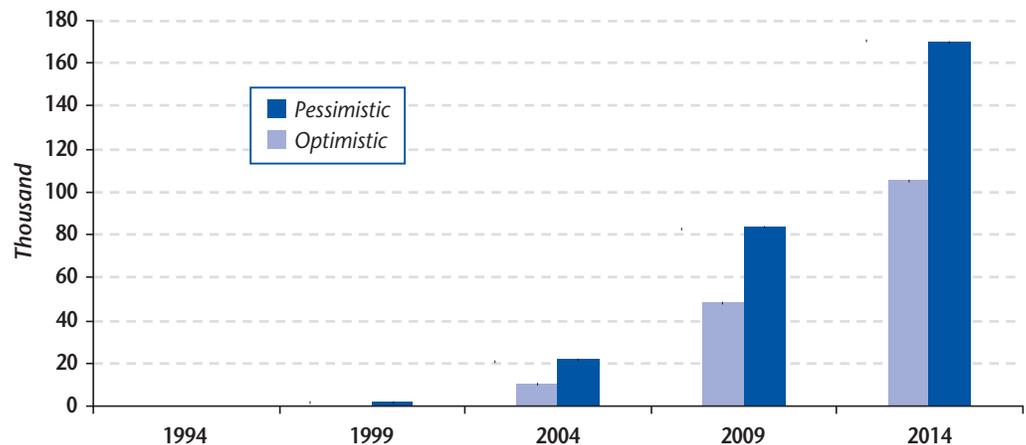
devastation becomes worse as it penetrates families and causes longer-term demographic damage. How the epidemic's impact will flow through different channels is discussed next.

First, premature death among many males of reproductive age will have a direct negative effect on the number of male partners available to form families. This reduction together with traditional preferences for legal marriages when making family-planning decisions will slow the family formation process, reducing birth rates.

Second, the economic burden may change, as the dependency ratio (the ratio of the economically dependent part of the population, either too young or too old to work, to the productive part of the population) increases. The economic burden on females will increase, as a gender role shift already observed in Ukraine during the period of economic downturn with women taking over as main family breadwinners. In this context, AIDS will make the burden of responsibility for family survival on females even harder (SIFYA 2004; UISS 2002).

Third, premature parent deaths will increase the number of orphans. The study forecast suggests that in 2014 the number of AIDS orphans will reach 105,100 in the optimistic and 169,300 in the pessimistic scenarios (Figure 3-8). Dual orphans and semi-orphans may receive limited parental support or must be cared for by the state, and their access to quality education and human development is impeded. For instance, young adults' access to higher education in Ukraine correlates strongly with the financial and social status of their family. AIDS orphans will live in financially disadvantaged households, often unable to achieve the same educational attain-

**Figure 3-8. Forecasted Total AIDS Orphans,\* 1994-2014**



\* Children orphaned as a result of death due to AIDS of one or both parents.

Source: Authors' calculations.

ment as children from complete families. All of this contributes to social inequality and instability.

The HIV/AIDS epidemic affects not only those infected, but also their families, households, and society at large. It impacts human resources not only in terms of quantity, but also quality. Not only does the size of the labor force decrease due to increased mortality among the younger age groups, but labor productivity falls as well. Also, if the epidemic becomes generalized, it will hinder the process of human capital accumulation by reducing considerably both the time available to recoup investment in human capital and rates of return to such investment. This study demonstrates that the HIV/AIDS epidemic in Ukraine leads to both quantitative and qualitative labor force losses.

### Analysis at the Regional Level

The geographic distribution of HIV/AIDS in Ukraine is non-uniform, and regional demographic patterns vary. To study regional variation in the demographic impact of the HIV/AIDS epidemic, separate demographic and epidemic forecasts were built for Dnipropetrovsk, Donetsk, Mykolayiv, and Odesa Oblasts, the worst-affected regions. Separate epidemic forecasts are constructed using two scenarios (optimistic and pessimistic) for all these oblasts but

Dnipropetrovsk, where only a pessimistic scenario is presented, due to limited surveillance data.

Regional differentials in socioeconomic development and social environment are linked to the demographic trends and the HIV/AIDS profile. Dnipropetrovsk and Donetsk Oblasts are located in the southeast, boasting the highest economic potential, high levels of economic activity, and high population density. They are highly industrialized and urbanized oblasts with environmental degradation. At the same time, they are facing the most unfavorable demographics in Ukraine, characterized by a considerable loss of population in the 1990s. In particular, over the last decade the natural annual population decline in Dnipropetrovsk Oblast was 30,000 persons and in Donetsk Oblast, over 45,000 (8.7 and 10.8 per 1,000 population, respectively). Low life expectancy, high death rates among the working-age population (especially in males, driven by high rates of accidents, poisonings, and trauma), and very low birth rates accompanied by the highest abortions rates in Ukraine, are all found in Dnipropetrovsk and Donetsk Oblasts.

Odesa and Mykolayiv Oblasts are in the southern region, an industrial, agrarian, and recreational region with an average level of socioeconomic development and some degree of environmental degradation. The population has a mixed ethnic composition that is changing through migration. Low life expectancy, high death rates from external causes and infectious diseases (TB, above all), and average birth rates characterize these oblasts' demographics. Over the last decade, annual natural decline in the population constituted almost 7,000 persons in Mykolayiv and 14,500 in Odesa Oblasts (or 7 per 1,000 population in both).

Factors with a negative effect on the social and demographic situation in these oblasts include:

- A high share of employment in industrial sectors with unsafe labor conditions and high risk of trauma;
- Environmental degradation; and
- A high crime rate aggravated by the inflow of refugees, migrants, and marginalized groups.

The adverse demographic situation in these oblasts is combined with both high prevalence of intravenous drug use and HIV infection. HIV prevention programs among high-risk groups are actively implemented in Odesa and Mykolayiv Oblasts and to a much lesser degree in Dnipropetrovsk Oblast.

The study predicts that most of the demographic losses associated with the epidemic will accrue to these four oblasts, with a subsequent negative impact on the regional economies. The number of people infected with HIV in 2014 in these oblasts is predicted to constitute 36-43 percent of Ukraine's total HIV cases, while only a quarter of its population resides there. The predicted numbers of those infected in 2014 is 32,500-44,200 in Mykolayiv; 48,900-116,100 in Odesa; 85,300 in Dnipropetrovsk; and 92,200-105,600 in Donetsk (Annex 2 Table A2-5). The contributions of Donetsk and Odesa Oblasts to the total number of infections will increase from 11-12 percent and 5-7 percent, respectively, of the national total in 2004 to 13-19 percent and 10-14 percent, respectively, in 2014.

Annual AIDS deaths are predicted to reach 2,000-3,000 in Mykolayiv Oblast and 6,000-9,000 in Donetsk Oblast in 2014 (Annex 2 Table A2-6). The accumulated AIDS deaths will increase considerably in the four oblasts and will account for 23-30 percent of the national total in 2014 (Annex 2 Table A2-7).

While the greatest loss of lives to AIDS are in the working-age groups, the absolute number of AIDS deaths does not reflect the real gravity of AIDS' contribution to increased mortality: the latter depends on the age-gender composition of a regional population. Thus, to compare AIDS-related mortality in the working-age populations across oblasts, the study used both the share of AIDS deaths in total number of deaths in the 15-59 age group and mortality (deaths per 100,000 population in the relevant age group) as indicators. The analysis shows that by 2014, AIDS will account for about a third of all deaths in the working-age group (Table A2-8). Mykolayiv and Odesa are hardest hit (discounting Dnipropetrovsk for which no optimistic scenario was drawn) with the highest AIDS death rates per

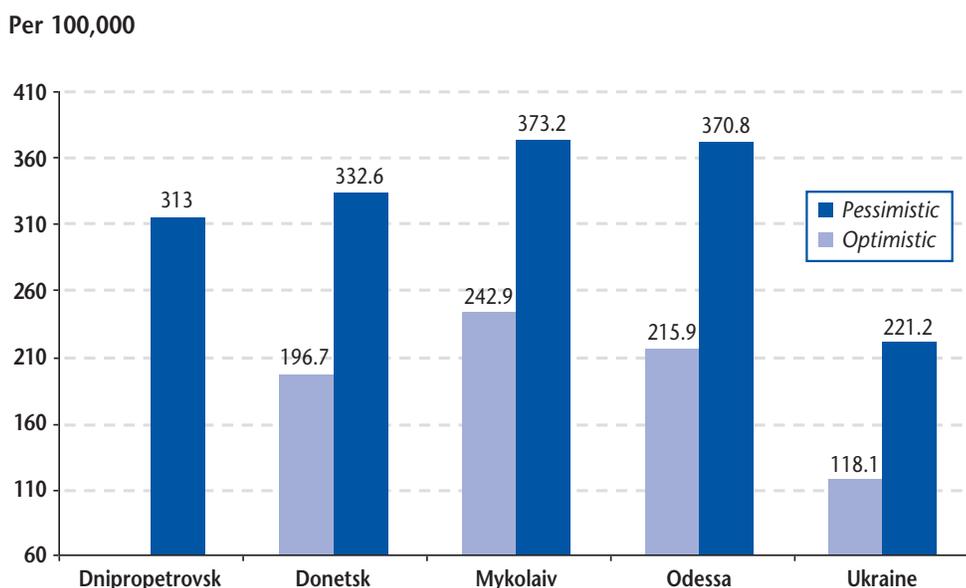
100,000. All four oblasts are significantly above the national AIDS death rates among the working-age population by an estimated factor of 1.4 in Dnipropetrovsk, 1.5-1.7 in Donetsk, 1.7-1.8 in Odesa, and 1.7-2.1 in Mykolayiv Oblasts in 2014 (Figure 3-9).

The epidemic's impact on life expectancy for four oblasts is shown in Figure 3-10 on page 18. As the HIV/AIDS epidemic continues to spread, the maximum reduction in life expectancy in the forecast period occurs in 2014, when AIDS-related mortality peaks for this period. Odesa and Mykolayiv Oblasts will suffer the most, with AIDS shaving an estimated 3.4-4.1 years off male life expectancy and 4.3-5.2 year off females' under the optimistic scenario, and a corresponding 6.5-7.1 (males) and 7.7-7.8 years (females) under the pessimistic one (Annex 2 Table A2-9). This aggravates the already-unfavorable regional demographic situation, with crude death rates higher and life expectancy lower than the national average.

The epidemic's effect on birth rates derives from the fact that HIV-infected females demonstrate relatively lower fertility, so the absolute number of births during the epidemic drops. Based on our calculations, the cumulative number of unborn babies due to the infection of potential mothers is 380-610 in Mykolayiv, 410-650 in Odesa, 2,000-3,500 in Donetsk, and 2,700 in Dnipropetrovsk Oblasts.

Both regional epidemic scenarios are superimposed on the baseline population decline. In 2014, the

**Figure 3-9. Estimated AIDS-Related Mortality in the Working-Age (15-59) Population in Dnipropetrovsk, Donetsk, Mykolayiv, and Odesa Oblasts and Ukraine, 2014**

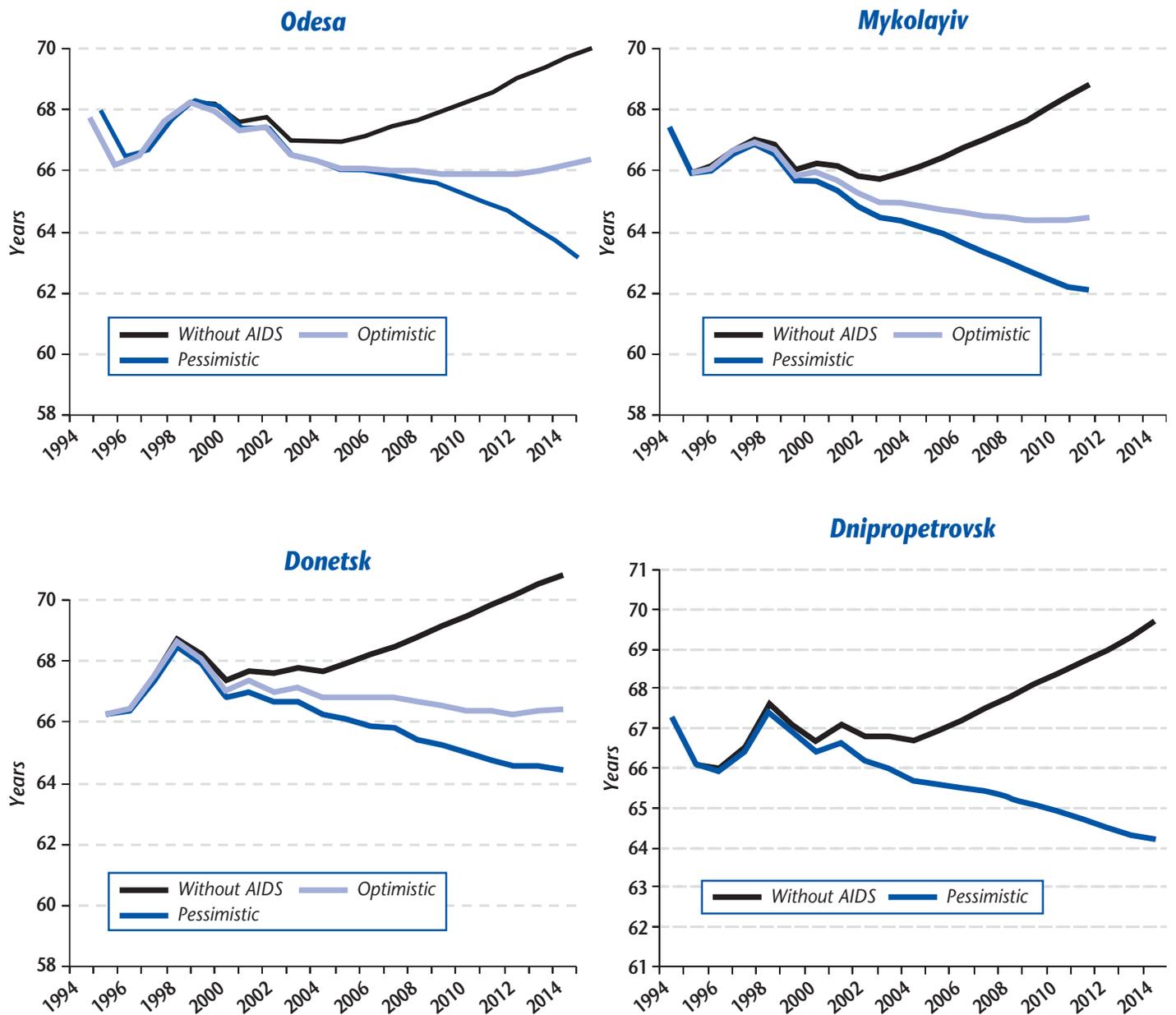


Source: Authors' calculations.

population of Dnipropetrovsk Oblast will decline by an extra 40,000 due to the epidemic. Similarly, demographic losses in "with AIDS" compared to "no-AIDS" scenarios are 40,000-60,000 in Donetsk, 20,000-30,000 in Odesa, and 10,000-20,000 in Mykolayiv Oblasts. Clearly, AIDS accelerates the already-rapid population decline in these oblasts (Annex 2 Table A2-10).

The analysis above suggests that the impact of HIV/AIDS on regional demographic processes will be long lasting and continuing beyond this study's forecast horizon. The HIV/AIDS epidemic will aggravate the current negative trends in the regional population dynamics. The epidemic's demographic impact is likely to impose a heavy burden on all four oblasts, hindering their economic and social development.

**Figure 3-10. Forecasted Life Expectancy\* in "No-AIDS," "AIDS Optimistic," and "AIDS Pessimistic" Scenarios, Odesa, Mykolayiv, Donetsk, and Dnipropetrovsk Oblasts, 1994-2014, in Life Years**



\* For both males and females.

Source: Authors' calculations.