Socioeconomic Impact of HIV/AIDS in Ukraine

Альянс
International HIV/AIDS Alliance in Ukraine

THE WORLD BANK

1818 H Street, NW
Washington, DC 20433, U.S.A.

Manufactured in the United States of America
First Printing: May 2006

Library of Congress Cataloging-in-Publication Data has been requested.

Socioeconomic Impact of HIV/AIDS in Ukraine

Альянс
International HIV/AIDS Alliance in Ukraine

THE WORLD BANK

Table of Contents

List of Figures

List of Tables

List of Abbreviations

ANC	Antenatal Clinic
AR	Autonomous Republic
ART	Antiretroviral Therapy
ARV	Antiretroviral
CGE	Computable General Equilibrium
CIS	Commonwealth of Independent States
CPI	Consumer Price Index
DALY	Disability Adjusted Life Year
EGW	Electricity, Gas, and Water
FDIs	Foreign Direct Investments
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GFATM	Global Fund for AIDS, Tuberculosis and Malaria
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
IDUs	Injecting Drug Users
ILO	International Labor Organization
M3	Broad Money Aggregate
MARP	Most-at-risk Population
MOH	Ministry of Health
MTCT	Mother-to-Child Transmission
NAS	National Academy of Sciences
NBU	National Bank of Ukraine
OLG	Overlapping Generations
PPI	Producer Price Index
SPF	Social Protection Fund
STI	Sexually Transmitted Infection
TB	Tuberculosis
TFP	Total Factor Productivity
UAH	Hryvnia
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Program
VAT	Value Added Tax
WHO	World Health Organization
YLD	Years Lost to Disability
YLL	Years of Life Lost

Currency is Hryvnia or UAH: Exchange rate 1US$ = 5.3 UAH.

Acknowledgements

This study was jointly conducted by the World Bank and a group of Ukrainian experts in collaboration with the Joint United Nations Program on HIV/AIDS (UNAIDS) and the International HIV/AIDS Alliance in Ukraine through the support from the Global Fund for AIDS, Tuberculosis and Malaria. The World Bank team is led by Shiyan Chao, Senior Health Economist, and includes Alexandra Sidorenko, Consultant, Australian National University. The Ukraine team consists of Olga Balakireva, Social Monitoring Center of Ukraine; Nina Baranova, Center for Perspective Social Studies, Ministry of Labor and Social Policies; Igor Burakovsky, Institute for Economic Research and Policy Consultations; Irina Demchenko, Socioconsulting Analytical Center; Yuriy Kruglov, Ukrainian National AIDS Center, Ministry of Health, Ukraine; Nataliya Levchuk, Institute of Demography and Social Research, National Academy of Sciences (NAS) of Ukraine; Zoryana Medvid, Center for Perspective Social Studies, Ministry of Labor and Social Policies and NAS of Ukraine; Oleg Nivyevskiy, Institute for Economic Research and Policy Consultations; Ferdinand Pavel, Institute for Economic Research and Policy Consultations; Nataliya Polyak, Center for Perspective Social Studies, Ministry of Labor and Social Policies and NAS of Ukraine; Mariya Skrypnichenko, Institute for Economic Forecasting, NAS of Ukraine; Maryna Varban, Socioconsulting Analytical Center; Olexandr Yaremenko, Ukrainian Institute of Social Research; Pavlo Smyrnov, Anna Dovbakh, Lyudmyla Husak, Andrey Klepikov, International HIV/AIDS Alliance in Ukraine; and Valeriy Khmarskiy, Ministry of Health of Ukraine.

Alexandra Sidorenko provided methodological support to the study. She and Shiyan Chao prepared the final report. Vinay Saldanha from UNAIDS contributed to the study. Olena Bekh from the World Bank, Kiev office, provided coordination between the Bank and the Ukraine research team. Beth Goodrich edited the report.

The study team is thankful to the study peer reviewers, Martha Ainsworth, Mattias Lundberg, and Edmundo Murrugarra from the World Bank and Marc Suhrcke from World Health Organization (WHO), for their valuable comments.

The team is grateful to World Bank managers Paul Bermingham, Country Director of Ukraine, Belarus, and Moldova, and Armin Fidler, Health Sector Manager, for their guidance and support to the study. The team is also grateful for comments and suggestions received from Toomas Palu, Jack Langenbrunner, and Merrell Tuck-Primdahl, the World Bank; Alla Scherbinskaya, Ukrainian National AIDS Center; Arkadiusz Majszyk, Anna Shakarishvili, and Lidiya Andruschak, UNAIDS; Veena Lakhumalani, the British Council; and Yuriy Kobyscha and Ariele Braye, WHO, Ukraine Office. Financial assistance from UNAIDS Trust Fund is gratefully acknowledged.

Executive Summary

This study of the socioeconomic impact of HIV/AIDS in Ukraine was prompted by the need to understand the potential impact of the country's rapidly growing HIV/AIDS epidemic. Ukraine was classified by the World Health Organization as a low HIV prevalence country in 1995, but only a decade later, Ukraine suffers the worst HIV/AIDS epidemic in Europe (DeBell and Carter 2005). Clearly, it is collective failure that prevents Ukraine from controlling the epidemic. Lack of understanding of the epidemic and its potentially devastating impact contribute to stigma, denial, and inadequate responses.

The World Bank and the Ministry of Health of Ukraine jointly conducted this study in collaboration with the Joint United Nations Programme on HIV/AIDS (UNAIDS) and the International HIV/AIDS Alliance in Ukraine.

The study assesses the short- and medium-term (2004-14) socioeconomic impact of the HIV/AIDS epidemic and provides evidence for policy making. Using data available in January 2005, it evaluates the epidemic's impact on population growth, life expectancy, employment, and health care and social service costs in Ukraine and projects the potential benefits of disease prevention and treatment. Data from the Ukrainian AIDS Center and socioeconomic information from the government and other agencies were used to construct a baseline "no-AIDS" demographic projection of the Ukrainian population and three epidemic scenarios—optimistic, medium, and pessimistic.[1] These projections were used to apply several macroeconomic models to estimate the impact of the HIV/AIDS epidemic on various subpopulations, regions, and sectors.

Ukraine's HIV/AIDS Epidemic

Ukraine's rate of HIV infection is growing fast. HIV/AIDS is a relatively new phenomenon for Ukraine, with rapid spread of the virus only since 1994. Consequently, the overall prevalence rate is still relatively low, but the rate of infection increase is alarming: an average 33 percent increase per year since 1994. UNAIDS estimates that Ukraine had 360,000 infected adults as of the end of 2003 and an adult prevalence rate of 1.4 percent. (The exact number of infections is unknown due to the high degree of uncertainty associated with the size of the most-at-risk populations.) This study projects that nearly a half million people (477,000) were infected with HIV in 2004, a 32 percent increase over 2003. It also projects that, by 2014, the total number of HIV-positive people will range from 478,500 under the optimistic scenario to 820,400 under the pessimistic one. The adult prevalence rate will be between 1.9 and 3.5 percent, depending on projection assumptions.

The pattern of transmission is changing. Until now, the HIV epidemic in Ukraine was concentrated in sub-populations, mainly injecting drug users

[1] Epidemic scenarios differ in their assumptions about the size and dynamics of the most-at-risk populations, yielding different estimates of adult prevalence rates. In our optimistic scenario, the adult HIV prevalence rate peaks at 2% in 2010, peaks at 2.48% in 2009-10 in the medium scenario, and rises continuously, reaching 3.5% in 2014 in the pessimistic scenario. Reduction in the vertical transmission rate (15.9% in 2003) is faster in the optimistic scenario (to 10% in 2004 and then to 5% in 2014) than in medium (gradual reduction to 5% by 2014) and pessimistic scenarios (gradual reduction to 10% in 2014). Availability of antiretroviral (ARV) therapy to those who need it increases from 1% in 2004, to 30% in 2010, and further to 50% in 2014 in the optimistic scenario; to 5% in 2005, further to 10% by 2010, and remaining at 10% until 2014 in the medium one; and to 5% in 2005 and remaining at 5% until 2014 in the pessimistic scenario. The study also constructed three cost scenarios for antiretroviral therapy (ART).

(IDUs), with the prevalence rate among pregnant women in urban areas still below 1 percent. Barnett et al. (2001) pointed out that the epidemic was shifting from high-risk groups to the general population through heterosexual transmission. Feshbach and Galvin (2005) reinforced this conclusion in their recent article. The epidemic's tendency to spill into the general population is reflected in official Ukrainian AIDS Center data indicating that the share of infections caused by intravenous drug use decreased from 83.6 percent in 1997 to 46.5 percent in 2004, while the percentage of heterosexually transmitted infections grew from 11.3 percent to 32.4 percent. This change in the transmission pattern calls for more aggressive measures to curb the epidemic's spread in the general population.

The young and women are hit hardest. 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, it is estimated that the 20-34 age group will account for three-quarters of all new HIV infections, half of which will be among women.

HIV/AIDS is unevenly distributed across the country. Among the worst-affected regions are those in the southeast oblasts of Donetsk, Dnipropetrovsk, Odesa, and Mykolaiv. Accounting for only a quarter of the total population of Ukraine, these regions will bear an estimated 36-43 percent of accumulated HIV cases by 2014 and 31-38 percent of annual AIDS-related deaths. Donetsk Oblast will account for 13-19 percent of Ukraine's HIV infections, followed by Odesa Oblast at 10-14 percent. The epidemic in these oblasts is unfolding against a backdrop of natural population decline, which is faster than the national average. By 2014, AIDS-related death rates in these two oblasts will exceed the national average by a factor of 1.5-2.1.

Socioeconomic Impact of HIV/AIDS

The epidemic's impact on demographics and health status could be devastating. The largest demographic impact of the HIV/AIDS epidemic in Ukraine is through its effect on population morbidity and mortality rates. The majority of all HIV infections are among those in the most active reproductive age (20-34). The disease certainly affects their capacity for childbearing, and Ukraine has persistently declining birth rates. Over 1991-2003, the Ukrainian population declined by almost 4 million, an average of 300,000 per year. Given the shrinking size of the young adult groups and the persistent demographic decline, even modest increases in adult prevalence rates could result in a strong long-term demographic impact.

The study estimates that the number of new AIDS cases reached 13,700 in 2004, and annual AIDS deaths were approaching 10,000 even in the optimistic scenario. By 2014, AIDS-related deaths will account for almost a third of all male deaths in the 15-49 age group and 60 percent of female deaths in that age group. In 2014, AIDS is projected to reduce male life expectancy by 2-4 years: from 65.6 in the hypothetical "no-AIDS" scenario to 63.4 (optimistic) and 61.6 (pessimistic) scenario. Similarly, a female born in 2014 will be expected to live three years less (to age 72.9) in the optimistic scenario and almost five years less (to age 71.0) in the pessimistic one, instead of an expected 75.8 years in the "no-AIDS" scenario. A potentially catastrophic increase in HIV/AIDS morbidity and mortality is expected in the medium term if prevention measures fail. Also, several complicating factors exacerbate the situation: the demographic decline, the high prevalence of tuberculosis (TB) and sexually transmitted infections (STIs), and a generally weak health system.

HIV/AIDS has become one of the major obstacles to economic growth in Ukraine. AIDS affects all agents in an economy: households, businesses, and the government, and its effects impact many of the economy's aspects: greater mortality and morbidity; reduced labor supply, labor efficiency, and labor productivity; loss of investment

in human capital and diminished returns to such investment; increased health care spending and the loss of tax revenues; and decreases in public and private savings and investment, among others. Reduced fertility among women infected with HIV amplifies the demographic decline and is responsible for longer-term effects. Based on various plausible AIDS scenarios during 2004-14, the study found an expected 1-2 percent reduction in the labor force due to the epidemic. In addition, since the younger groups are most affected, the labor force losses will be felt for a long time. Furthermore, HIV/AIDS in Ukraine has a pronounced gender differential: the sharpest decline in labor force participation is for females in the 15-19 age group. This decline is in addition to the labor force reduction due to the underlying demographic trend, estimated to be a 10.4 percent fall by 2014 from the 2004 rate. In the worst-affected oblasts, the contribution of HIV/AIDS to labor force shrinkage is more pronounced: an additional estimated 2.7 to 3.6 percent for Donetsk and 2.2 to 4.2 percent for Odesa Oblasts.

The phenomenon of children being orphaned to HIV/AIDS is already taking a toll on both society and *households* in Ukraine. According to the medium scenario, Ukraine will have 42,000 dual orphans due to AIDS-related deaths of both parents by 2014. The number of children who have lost at least one parent to AIDS is projected to reach 105,000-169,000 by 2014, depending on the scenario. Those children are at risk of impeded access to quality education, health care, and even basic needs, which in turn puts them at higher risk for unemployment, diseases, and poverty. Without adequate social assistance from the government and society at large for these children, a vicious cycle results.

Medical expenses associated with treating HIV/AIDS and opportunistic infections can become catastrophic at the household level, driving poor households below the poverty line. This is particularly true in countries such as Ukraine, with weak social and private insurance systems. This study makes explicit assumptions about availability and price of antiretroviral therapy (ART) to devise cost scenarios for drugs and hospitalization. Depending on the cost scenario selected, total annual AIDS care expenditure is estimated to be 41 million-629 million hryvnia (UAH) by 2014. (This wide range is due to the high degree of uncertainty about the future costs for both antiretroviral [ARV] and non-ARV medical treatment.)

At the *business level*, the negative impact of HIV/AIDS usually includes greater direct expenditures for medical treatment, larger contributions to sickness/disability/death benefits, and the loss of investment in recruiting and training employees.

For the *health sector*, health budgets take a direct blow from the increased demand for hospital and outpatient services, with bed occupancy by HIV/AIDS patients stretching available resources. Furthermore, the medical workforce itself is likely to be decimated by the epidemic, causing a clash between growing demand for professional care and a shrinking pool of medical professionals.

In the *public sector*, HIV/AIDS impacts both revenue and expenditures. The loss of productive time for income-generating activities lowers the tax base, shifting more of the tax burden to the healthy remainder, who may in turn respond by reducing their labor supply. Like the medical sector, the public and business sectors are also likely to lose their employees to the epidemic. Direct budget revenue losses through the fall in employment due to HIV/AIDS, forgone income taxes, and unpaid pension and social security (temporary disability and unemployment) levies are estimated to reach 263-418 million UAH (in optimistic-pessimistic scenarios). At the same time, the projected additional budget expenditure in 2014 will add 109-200 million UAH for permanent disability pensions due to HIV/AIDS, 20-35 million UAH in pensions from the Social Protection Fund, 7-12 million in temporary HIV disability payments, and 3-8 million in AIDS orphan pensions. The total HIV/AIDS-related, government-funded additional benefits are estimated to be 139-255 million UAH per year by 2014.

Other negative effects include an increase in the country risk premium and possible effects on trade (both in goods and services) and balance of payments.

A comparison of the non-AIDS scenario with optimistic and pessimistic outcomes shows that Ukraine could experience a 1-6 percent reduction in the level of output (gross domestic product, or GDP, in constant prices), a 2-8 percent reduction in total welfare, and a 1-9 percent reduction in investment.

Sectoral analysis suggests that labor-intensive sectors whose labor inputs suffer from the epidemic will be among the worst affected. In the sectoral analysis based on the computable general equilibrium (CGE) model, sectors such as those producing non-energy materials and processing metallurgy and metal were found to be the most affected, with output falling by up to a third in the worst-case scenario. Given the relative share of these sectors in the country's trade structure, the pessimistic scenario's fall of 40 percent in exports of these sectors translates into a 5.5 percent fall in GDP, an 8 percent fall in total welfare, and a 9 percent fall in investment.

The availability of ART provides hope for extending life expectancy and healthy years to infected people with treatment access. The study estimates that the cost of ART ranges from 353 million UAH under the optimistic case (with 50 percent of AIDS patients in need treated) and 52 million UAH under the pessimistic one (with only 5 percent of patients getting treatment). However, without adequate treatment, such as in the pessimistic case, the cost for caring for AIDS patients is more than 80 percent higher than that cost under the optimistic ART case. The analysis confirms that providing ART is a cost-effective measure under a range of scenarios with respect to the cost of treatment. In the low-cost scenario, as little as 419 UAH per person per year on average is required to prevent a new HIV infection. Even in the high-cost scenario, it costs an average of 762 UAH per person per year to prevent one new infection, net of avoided hospitalization costs.

Policy Implications

In line with other international studies, the results from this study demonstrate that the HIV/AIDS epidemic has serious consequences for Ukraine's society and jeopardizes future development. In the medium term, the study shows a significant impact on economic growth, investment and social welfare, life expectancy, and population growth. If current trends continue without effective control of the epidemic, the longer-term impact could be much more devastating. The cost of inaction or ineffective action would be prohibitive.

The epidemic's distribution as shown in this study calls for attention to and effective targeting of youth, females, and the worst-infected oblasts. Prevention and treatment programs must reach these target groups, and messages and services must fit their needs.

The current transmission pattern signals a need for a prevention strategy focused on harm-reduction programs as well as sex education for youth. Even though the mode of transmission is evolving towards heterosexuals, IDUs still constitute the majority of those infected; special effort must be made to reach them.

Donetsk, Dnipropetrovsk, Odesa, and Mykolaiv Oblasts are among the worst-affected regions. Given the important role they play in Ukraine's economy, these regions should be treated with priority in implementing HIV prevention, education, and treatment measures.

Due to data limitations, this study could only model the impact of ARV treatment as one of the possible interventions. The study demonstrates that providing ARV treatment can be cost-effective and that scaled up treatment is the key to avoiding escalating health costs. ARV treatment needs to be complemented with preventive education to curb the epidemic's spread.

The epidemic is still at the early stage in Ukraine, which means that timely, effective interventions, including the availability of ARV treatment, could halt and reverse the epidemic and reduce its impact on socioeconomic development.

CHAPTER 1 Introduction

This study was prompted by the rapid growth in Ukraine of the HIV/AIDS epidemic and its threat to the general population and economy. According to estimates from the Joint United Nations Programme on HIV/AIDS (UNAIDS), 360,000 (range: 180,000 to 590,000) people were living with HIV/AIDS in the country as of late 2003, with an adult (age 15-49) prevalence rate of 1.4 percent (range: 0.7 to 2.3 percent). The exact number of infections is unknown, but the officially registered new HIV cases reported each year doubled over four years: from 6,216 in 2000 to 12,491 in 2004. In addition, 2000-2004 witnessed a four-fold increase in the annual official numbers of new AIDS cases and AIDS deaths. Between 1994 and 2005, Ukraine's epidemic was concentrated in sub-populations, mainly injecting drug users (IDUs), with the prevalence rate among pregnant women in urban areas still below 1 percent. However, a Barnett et al. (2001) study's warning to take very seriously the probability of a "generalized"[2] heterosexually transmitted epidemic was reinforced in Feshbach and Galvin (2005), who deduce that "all the evidence, however incomplete, suggests that a heterosexual epidemic has certainly begun." The epidemic's tendency to spill into the general population is reflected in official Ukrainian AIDS Center data: the share of infections caused by intravenous drug use decreased over 1997-2004 from 83.6 percent to 46.5 percent, while the percentage of heterosexually transmitted infections grew from 11.3 percent to 32.4 percent. To prevent the epidemic from becoming self-sustaining outside of the risk groups, such as IDUs, commercial sex workers (CSWs), and people with sexually transmitted infections (STIs), effective prevention and education are called for.

High-risk groups remain the worst affected by the epidemic: 2004 sentinel surveillance data indicate that the average prevalence rate among IDUs is 37.2 percent, and among commercial sex workers (CSWs) it is 22.2 percent. At the same time, mounting evidence shows that the wider population is increasingly at risk, mostly through heterosexual contacts. Potential catastrophic increases in HIV/AIDS morbidity and mortality are likely in the medium term if measures to curb the epidemic fail. Several factors exacerbate the situation: persistent demographic decline, a high prevalence of tuberculosis (TB) and sexually transmitted infections (STIs), and a health system needing reform.

Access to antiretroviral therapy (ART) has been very limited but is expanding. A Global Fund for AIDS, Tuberculosis and Malaria (GFATM) pilot project for 200 patients is being extended to 2,000, and on July 1, 2005, 1,950 persons were receiving ART (Ukrainian AIDS Center data). By the following October, 2,866 AIDS patients were undergoing treatment funded by GFATM. In April 2005, ART was commenced in six of the country's worst affected areas: the oblasts of Donetsk, Dnipropetrovsk, Odesa, and Mykolaiv; the Autonomous Republic (AR) of Crimea; and Kiev city.

Although HIV/AIDS is becoming a major obstacle to economic growth in Ukraine, recognition of the need to re-assess priorities and implement an effective, anti-HIV/AIDS national strategy is growing. Losing the momentum of the recent economic recovery would be tragic after Ukraine's painful economic

[2] "Generalized" and "concentrated" epidemics are defined as follows: a concentrated epidemic has HIV prevalence in most-at-risk subpopulations at 5 percent or higher and among pregnant women in urban areas below 1 percent. In a generalized epidemic, social networking in the general population is sufficient to sustain the epidemic outside the most-at-risk sub-populations, and HIV prevalence among pregnant women is consistently above 1 percent. See http://data.unaids.org/Topics/Epidemiology/Manuals/EPP_GeneralizedEpidemic_05_en.pdf.

transition since independence in 1991. Prior to recent positive developments, Ukraine experienced a decade of severe political and economic instability and decline (World Bank 2004). An economic adjustment phase included extreme macroeconomic instability and hyperinflation in 1993. By 1998, the officially reported gross domestic product (GDP) had fallen to 40 percent of its 1990 level. Even if the degree of the actual fall is overestimated due to the large size of the informal sector, there was a severe economic decline and genuine hardship for many Ukrainians in the 1990s. The difficulties of the transition stage are reflected in Ukrainian demographic statistics, with life expectancy falling for males and females from 66 and 75 years to 62 and 73 years, respectively, between 1989 and 1997 (World Bank 2004). Furthermore, massive depopulation (by almost 4 million during 1991-2003) through reduced fertility and out-migration has accelerated a growing share of the elderly population. Superimposed on these demographic trends, the HIV epidemic suppresses already-low fertility even further, both deepening and extending population decline.

This study evaluates the broad economic effects of the epidemic, delving beyond the costs of prevention and treatment. Both near- and medium-term (2004-2014) cost estimates were developed to inform policy makers of the potential costs of the epidemic during this decade. To inform decision making on prevention and treatment programs, the study highlights the channels through which HIV/AIDS affects the national economy as well as households.

HIV/AIDS has a direct impact on human health, an input in economic development and an indispensable component of human capital.[3] Infectious diseases influence economic activities and economic growth both directly and indirectly. At the first instance, disease has a negative impact on healthy life expectancy. Early death and chronic disability result in the loss of future income and in medical care expenditures. The second effect includes reduced investment in one's own and one's children's education and health, especially in societies with high infant/child mortality and high fertility (a behavioral quality-quantity trade-off). Third is a negative impact on investment in the economy through the increased consumption of health care and an increased country risk premium. In addition to the quantifiable economic costs of disease, there are also intangible losses from pain and suffering.

HIV/AIDS affects all agents in the economy: households, businesses, and the government. On both the *household and business levels*, its direct effects are due to the increased mortality and morbidity (loss of years of healthy life, reduced labor supply, and reduced efficiency of labor due to illness). HIV/AIDS leads to changes in labor force composition due to its heavier effect on the productive-age population. AIDS-related mortality disproportionately affects people during their productive years; it also affects women more than men. Morbidity reduces healthy life years, causing increased expenditure on medical care with a negative effect on the income available for other purposes, including saving and household investment in human capital. A sick employee supplies fewer hours in the labor market, and sickness makes anyone less efficient. When other household members must leave the labor force to care for a sick family member, labor supply drops again. Lower fertility ultimately produces a longer-term negative demographic effect and fewer people to contribute to the economy. Also, the number of orphans rises with AIDS deaths, increasing the economic burden on the state and surviving family members. Last, medical expenses associated with the treatment of HIV/AIDS and opportunistic infections may become catastrophic at the household level, driving marginally poor households below the poverty line. This is particularly so in economies with underdeveloped social and private insurance markets. As a result, income inequality may worsen.

In the *private sector* HIV/AIDS affects employers through the loss of investment in recruiting and

[3] A positive correlation between health and economic growth has been established in Bloom and Sachs (1998), Bhargava et al. (2001), Cuddington, Hancock, and Rogers (1994), Cuddington and Hancock (1994), Robalino, Voetberg, and Picazo (2002), and Robalino, Jenkins, and Maroufi (2002) and analyzed in detail in WHO Commission on Macroeconomics and Health (2001) and Haacker (2004b).

training an employee who becomes disabled by AIDS. Loss of productive labor shifts the burden of contributing to benefits, including the pension system, to fewer healthy workers. This in turn may reduce benefits or healthy workers' labor supply.

The *public sector* can also encounter losses through its investment in recruiting and training of its labor force when its employees become sick. Public revenues drop when workers reduce their contribution, either due to illness or to give care to family members, which in turn means fewer people paying income taxes.

The *health sector* is likely to take a direct blow from increasing demand for medical care and reduced numbers of health workers due to the epidemic.

Other negative effects include likely effects on trade (both in goods and services) and on balance of payments.

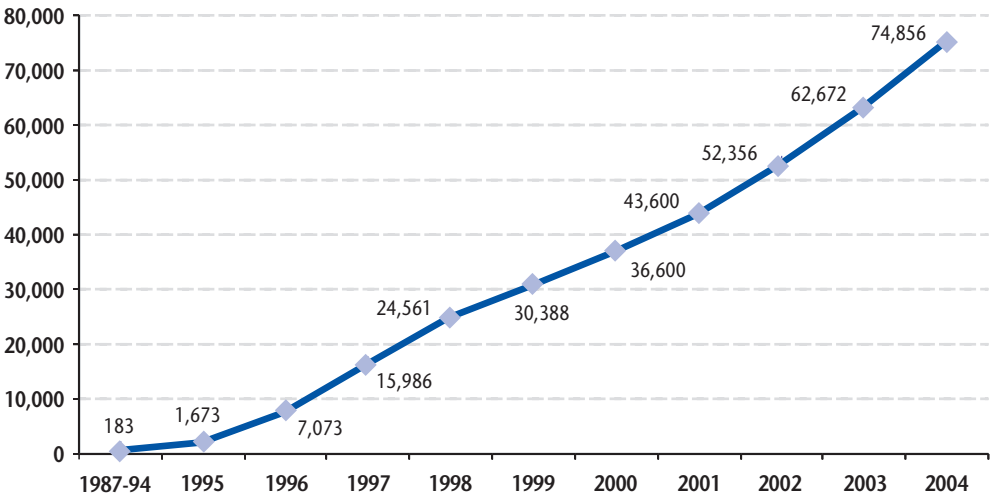
This study uses several methods to detail the likely impacts and costs of Ukraine's HIV/AIDS epidemic. Chapter 2 draws together available data to describe the current AIDS epidemic. Chapter 3 presents differing demographic impacts based on various projections with and without AIDS. Chapter 4 shows specifically where the impacts on the labor force and government revenue will be greatest, and Chapter 5 estimates the cost of the epidemic and implications of providing ART. Chapter 6 presents policy implications. The methodology, assumptions, and models and their results are detailed in the annexes.

CHAPTER 2 The HIV/AIDS Epidemic in Ukraine: Status and Trends

Ukraine's HIV/AIDS epidemic has been spreading at an alarming rate for the past few years, with officially registered new HIV cases per year reaching an all-time high of 12,595 in 2004, a 25 percent increase from 2003. Each day brings 32 new HIV diagnoses and 8 AIDS deaths among Ukrainians. Data from the Ukrainian AIDS Center (March 1, 2005) indicate that the cumulative number of registered HIV cases was 76,875 Ukrainian nationals, including 6,055 children as well as 314 foreigners. Those data also showed that 9,065 adults and 329 children developed AIDS, and 5,504 adults and 156 children died. Official HIV prevalence based on the registered cases is 115.4 per 100,000. Newer data (October 1, 2005) place the cumulative number of officially registered HIV-positive persons at 84,437, total AIDS cases at 11,757, and AIDS deaths at 6,865. This marks an additional 7,248 newly registered HIV cases, 2,363 AIDS cases, and 1,205 AIDS deaths in seven months. The number of new AIDS cases registered during March-October 2005 is almost as high as the official number of all AIDS cases registered in 2004 (2,745). A similar trend is seen for AIDS deaths: 1,205 deaths over March-October 2005 compared to 1,775 for all of 2004. Figure 2-1 illustrates the cumulative growth of officially registered HIV cases over 1987-2004. These data suggest that the epidemic is accelerating.

The recent increase in the number of new registered HIV infections was not driven by improved testing or more tests (Figure 2-2), an issue discussed more extensively below under "Non-uniformity across Regions and Sub-populations." It is important to note that the number of tests conducted has not increased appreciably since 1997. Annex 1 Table A1-1 reports officially registered new HIV and AIDS cases and AIDS deaths for 1987-2004, and Table A1-2 presents national HIV serosurveillance data by major category.

Figure 2-1. Cumulative Reported Cases of HIV Infection, 1987-2004



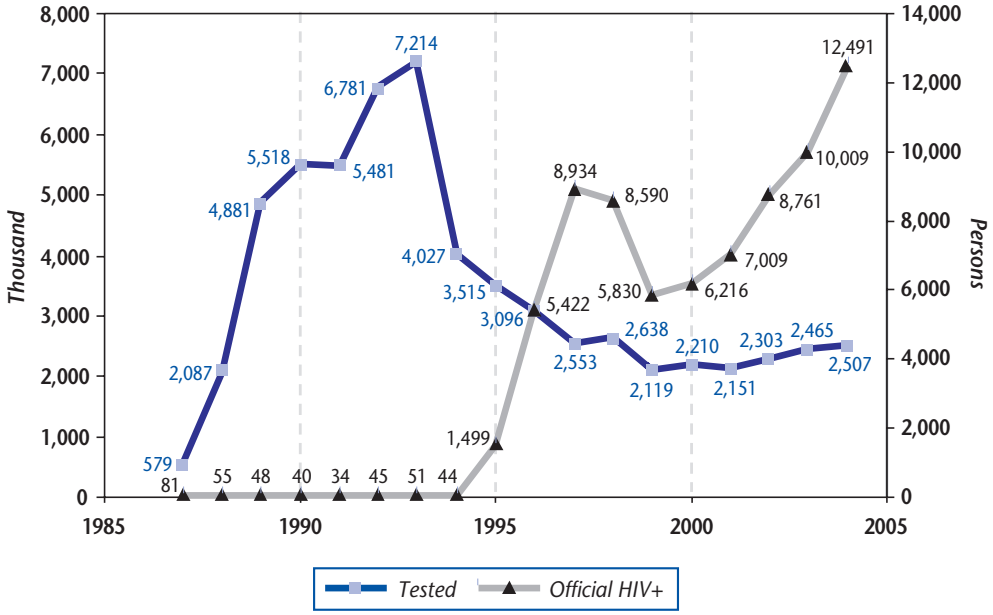
Source: Ukrainian AIDS Center.

The Changing Pattern of Transmission of the HIV/AIDS Epidemic

The leading modes of HIV transmission in Ukraine are through intravenous drug use, followed by heterosexual transmission. However, official data suggest that the share of transmission mode is shifting and that the epidemic has started to spread outside the high-risk groups through heterosexual transmission. HIV entered the population of intravenous drug users and expanded among them during

1995-98 through the sharing of contaminated needles and equipment. It is spreading increasingly through heterosexual contact. The share of IDUs among all new HIV victims dropped from 63 percent in 2000 to 46.3 percent in 2004, while the share of infection through heterosexual contact increased from 23 percent to 32 percent. During 2000-2004, the epidemic broadened, with the percentage of cases growing on average by 30 percent per year from heterosexual contact and by 32 percent per year from vertical transmission (mother-to-child transmission or MTCT). By comparison, the cases of HIV infection among the IDUs grew on average by 10 percent per year in 2000-2004. Male-to-male sexual contacts account for an insignificant number of reported cases (see Figure 2-3 on page 6 and Annex 1 Tables A1-2 and A1-3). One can visualize Ukraine's epidemic as the superimposition of three waves: an explosive spread among the IDUs, a slower but broader wave through heterosexual contacts, and—as a consequence of both—a third component through MTCT.

Figure 2-2. Total Numbers of HIV Tests and Officially Registered HIV Cases, 1987-2005



Source: Ukrainian AIDS Center.

HIV Sentinel Surveillance Data

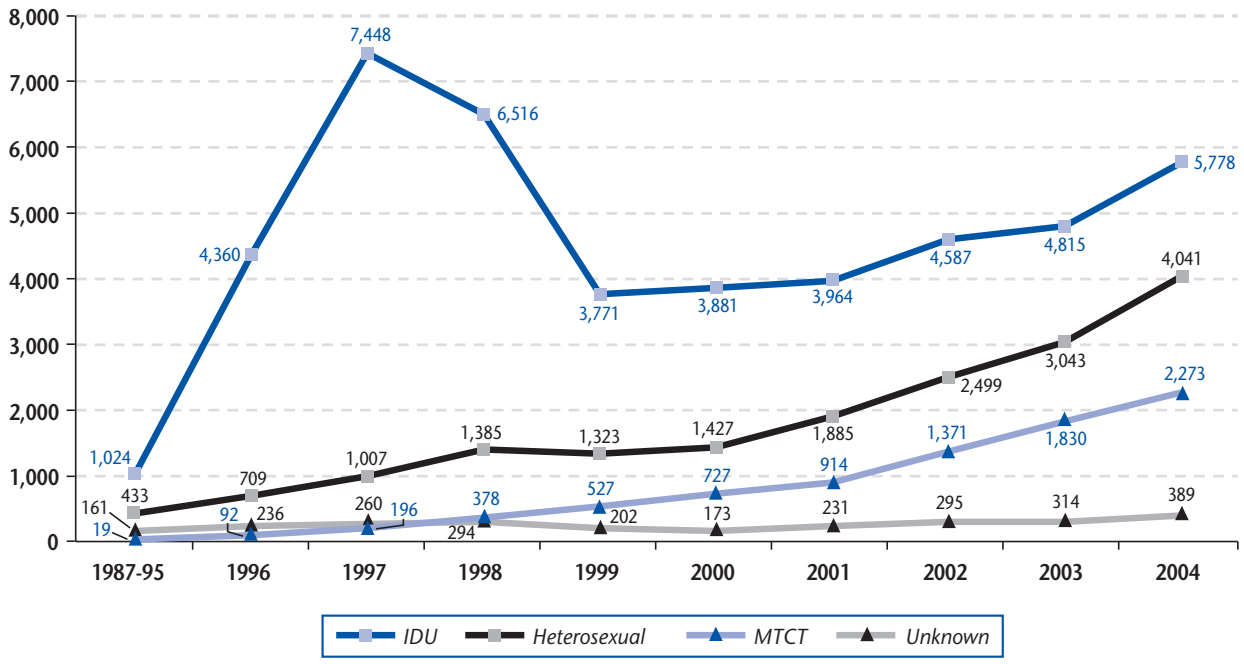
Serosurveillance data (Annex 1 Table A1-2) show that HIV seroprevalence among all tested increased from 0.75 percent in 2003 to 0.92 percent in 2004. Seroprevalence increases are also observed among pregnant women, reaching 0.34 percent in 2004, and donors, reaching 0.13 percent that same year. Females aged 15-30 are more likely to be infected through heterosexual contact than males of the same age, and almost half (47 percent) of the reported HIV cases are among females of the most active reproductive age, 20-29. Above the age of 30, males are more likely to be infected through heterosexual contact than females. The increased share of females from 36.5 percent to 42 percent of total HIV infections over 2000-2004 signals that the epidemic's generalization may have commenced (Annex 1 Table A1-5).

Ukrainian AIDS Center data indicate that the HIV/AIDS epidemic is unfolding in all regions, albeit non-uniformly (see Annex 1 Table A1-5). The worst-affected regions in terms of registered HIV prevalence are the oblasts of Donetsk (16,161 cases), Dnipropetrovsk (13,868), Odesa (10,855), and Mykolayiv (4,986); the AR of Crimea (4,976 cases); and Kiev city (3,144 cases). Most of those infected are aged 20-29. In terms of incidence rates, Dnipropetrovsk Oblast is the worst affected with 59.81 new cases of per 100,000 in 2004, closely followed by the oblasts of Odesa (58.92), Mykolayiv (57.49), and Donetsk (52.86); Sevastopol city (50.21); and the AR of Crimea (37.2).

Most-at-Risk Populations (MARPs)

The epidemic so far in Ukraine is still concentrated among certain population groups that are at higher risk of infection: IDUs, commercial sex workers

Figure 2-3. Leading Modes of HIV Transmission, 1987-2004



Source: Ukrainian AIDS Center.

(CSWs), men who have sex with men (MSM), people with sexually transmitted infections (STIs), and prisoners. Surveillance data on these groups enables forecasting the epidemic's future spread among them and extrapolations to estimate prevalence in the general population. The shape of epidemic profile will depend on the size of the risk groups and interactions between them and sexual partners from outside these groups.

As part of the HIV monitoring and surveillance program, HIV sentinel surveillance has been conducted since 1999 among the most-at-risk populations. The results among these groups suggest that the number of reported HIV cases is grossly underestimated based on the estimated HIV prevalence among the MARPs (Artyukh et al. 2005a).

Injecting Drug Users

The survey of HIV seroprevalence among IDUs indicates that in eight regions studied, seroprevalence ranged from 10-59 percent, confirming that IDUs, followed by CSWs, were a major driving force behind the epidemic in Ukraine.

The highest level of HIV infection among IDUs (59 percent) was recorded in Simferopol, more than double that found in earlier surveys (see Annex Table A1-7). Seroprevalence remains consistently high (58.3 percent) among IDUs in Odesa Oblast. Among IDUs in Donetsk it remained relatively unchanged over 2000-2004, at about 41.6 percent, but this does not indicate stabilization of the epidemic: Donetsk has the highest rate (55.6 percent) of new cases among very young (15-19) IDUs, perhaps indicating the rapid spread of infection among teenage IDUs in this region. Volyn Oblast posts a stable yet high HIV seroprevalence rate among IDUs of 32.8 percent.

The Poltava region has seen a reduction in surveyed HIV prevalence rates of IDUs, but more than a third of new cases (36 percent) occur in the 15-19 age group. The corresponding number for Odesa Oblast is 26.1 percent despite the generally higher seroprevalence rate among the IDUs. In Kharkiv the HIV prevalence among IDUs declined somewhat lately and now stands at 14 percent, while the Sumy Oblast IDU seroprevalence indicator (11.6 percent) is the lowest in the eight regions.

Commercial Sex Workers and STI Patients

HIV seroprevalence surveys were conducted among CSWs in five Ukrainian regions, where seroprevalence ranges from 11 percent in Kherson city to 31 percent in Odesa city (Artyukh et al. 2005b; see Annex 1 Table A1-8). The rising share of HIV transmissions through heterosexual intercourse has been driven in part by infections among CSW partners, many of whom inject drugs. The average HIV prevalence rate among all tested CSWs was 18.7 percent in 2002, 22.2 percent in 2004, and 8-32 percent in 2005 (Ukrainian AIDS Center, 2005).

HIV cases are also being reported increasingly in STI patients. Serosurveillance of this group indicates widely varying rates by region and year.

Men Who Have Sex with Men and Other Sexual Transmission

The lack of data for the group of men who have sex with men results from the limited accessibility to this group by survey programs. However, serosurveillance among the MSM groups conducted on a small sample in two cities reveals high prevalence rates (7 out of 25 tested in Odesa and 3 out of 22 tested in Simferopol: Amdzhadin et al. forthcoming). The sentinel surveillance report shows the prevalence rate among MSMs was between 10 and 30 percent in 2004 (Ukrainian AIDS Center).

Data reported in Annex 1 Table A1-9 also suggest that sexual transmission of HIV infection is rising.

Prisoners

Increasingly, HIV cases are also being reported among prisoners. From 1987 to the end of 2005, 14,998 new cases of HIV were diagnosed in the penitentiary system in Ukraine, and 999 prisoners had developed AIDS. Among the prisoners tested for HIV, 5.5 percent were HIV positive in 2002, and that rate increased to 9.4 percent in 2005 (State Department of Prisons).

Low-Risk Groups

Official data on low-risk groups such as blood donors and pregnant women provide an important means to monitor HIV's spread in the general population. Mandatory screening of blood donors for HIV has been in place since the 1989 Ministerial Order by the Ministry of Health. Donors in Ukraine receive a payment for donating blood (apart from donating to relatives) and may be motivated to donate by the payment. During 1998-2004, the share of infected donors rose from 0.07 percent to 0.13 percent. In 2004 the highest levels of HIV seroprevalence among donors were observed in Mykolayiv, Odesa, Dnipropetrovsk, Chernigiv, Donetsk, and Kiev Oblasts, all of which are the regions with the highest HIV prevalence apart from Chernigiv, which is below the national average incidence level (see Annex 1 Table A1-6).

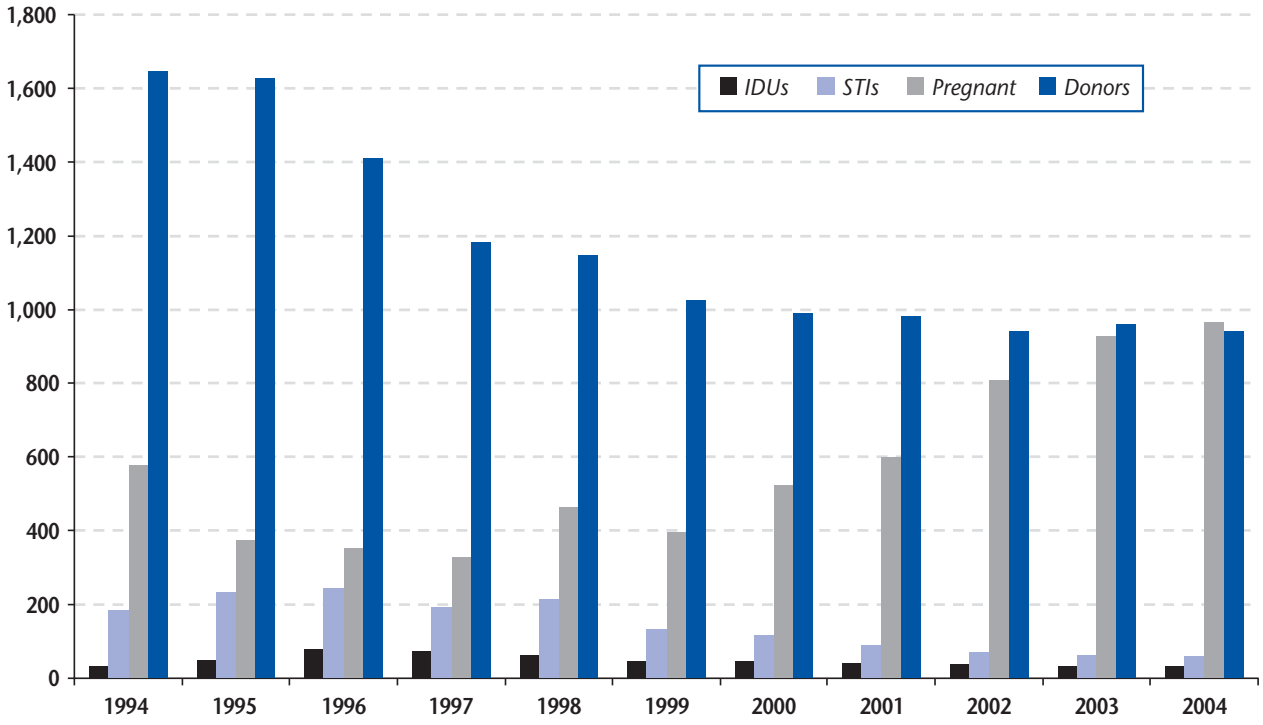
Seroprevalence among pregnant women also indicates epidemic trends in the adult population. According to Ukrainian AIDS Center data, the seroprevalence rate among pregnant women rose from 0.12 percent in 1998 to 0.34 percent in 2004, with the highest rates observed in Mykolayiv, Dnipropetrovsk, Donetsk, Odesa, Chernigiv, and Kiev Oblasts. The first four oblasts in this list have the highest IDU rates. Since 2000 measures have been implemented to prevent MTCT, targeting all pregnant women who agree to undertake voluntary HIV testing. In 2003, 15.9 percent of infants born to HIV-positive mothers tested positive, a 43 percent reduction compared to 2001.

Non-uniformity across Regions and Sub-populations

The above indicates that the epidemic spreads non-uniformly across regions and population groups, with the major explanatory factor being the geographic distribution of intravenous drug use. At the same time, the total number of HIV tests conducted among high-risk groups and other categories depends on the local administration and policies that also differ from oblast to oblast. The Ukrainian AIDS Center undertook epidemiological studies in 2004 to better understand the role of IDUs in shaping the national epidemic. The study concluded that official data on reported HIV cases are closely linked to HIV-testing practices. The targeted testing of IDUs had been relatively stable and somewhat reduced in

Figure 2-4. Total Number of HIV Tests Conducted, by Category, 1994-2004

In thousands



Source: Ukrainian AIDS Center.

recent years, while prenatal HIV testing had increased (see Figure 2-4). As a result, the increased share of females among new HIV cases and the reduced share of IDUs may be partially attributed to the change in the composition of the tested population.[4] Examination of data from Donetsk and Odesa Oblasts on those infected with HIV who passed the virus to their sexual partners revealed that in 50-60 percent of such cases, primary exposure of index patients to the virus occurred through sharing contaminated drug injection equipment. Hence, the heterosexual transmission to the sex partners can be traced back to the equipment use by the index patient in more than half of cases.

Based on the above, the Ukrainian AIDS Center study concluded that the epidemic continued to be concentrated among IDUs and their sexual partners. However, analysis by national and international experts (Barnett et al. 2001; DeBell and Carter 2005) indicates that the epidemic may be on the brink of spilling into the general population. Feshbach and Galvin (2005) discuss the debate on whether generalization has started in Ukraine and deduce that a heterosexual epidemic has certainly begun.

In sum, HIV infection is spreading at an increasing rate in Ukraine, with injecting drug use as the leading mode of transmission, but the share of the sexual transmissions is increasing, as is the share of MTCT: both signs that HIV infection is starting to penetrate the lower-risk population. While still low at the national level, the officially reported HIV incidence among pregnant women is 0.6 percent in Donestk and Odesa, 0.7 percent in Dnipropterovsk, and 0.8 percent in Mykolaiv Oblasts (Annex 1 Table A1-6). If this trend continues and further spread is sustained in the lower-risk group through heterosexual con-

[4] Note that the registered new HIV cases among pregnant women have increased from 0.12 percent of those tested in 1998 to 0.34 percent in 2004. This increase cannot be attributed to any change in testing practice and therefore reflects the spread of infection among females.

tact, the epidemic may become generalized, at least in the worst-affected oblasts.

As mentioned above, there are significant regional disparities in HIV prevalence in Ukraine. Among the worst affected are the industrialized oblasts of Donetsk, Dnipropetrovsk, Odesa, and Mykolayiv; AR Crimea; and Kyiv and Sevastopol cities. Sentinel surveillance studies of seroprevalence among the IDUs confirms that the southern region (Simferopol and Odesa cities) has the highest HIV prevalence rates among IDUs. High seroprevalence rates were also confirmed in the western region (Volyn Oblast). Seroprevalence rate estimates based on sentinel surveillance among STI patients vary from 1 percent in Kharkiv in northeast Ukraine to 9 percent in Odesa.

Ukraine's Response to HIV/AIDS

Within the European region, Ukraine is the worst-affected country, with the highest adult HIV prevalence rate. Public awareness of HIV/AIDS has been increasing, and in recent years, the government, nongovernmental organizations, and international agencies have improved the national response. The National AIDS Committee was established in 1992 and replaced by the National AIDS Control Coordinating Council under the Cabinet in 1999. The *Ukrainian National Program on HIV/AIDS Prevention for 2004-2008* was prepared, and various prevention programs are being implemented. As part of the public health system response, 35 regional AIDS centers are operating and provide preventive, diagnostic, medical, and counselling services through activities coordinated by the Ukrainian AIDS Center. At the district level, similar services are provided in district hospitals, through infectious diseases departments and consultation clinics. As of October 2005, 2,866 patients were receiving Highly Active Anti-Retroviral Therapy, but that is only about 15 percent of those needing it (Ukrainian AIDS Center, 2005).

The acceleration of the HIV/AIDS epidemic over 2002-04 requires re-estimation of the magnitude of the epidemic and its possible socioeconomic impact, taking into account new data on availability of ARV therapy, reduction in MTCT rates, and new estimates of the size of the IDU group as of January 2005. The results of such analysis are presented in Chapter 3.

CHAPTER 3 Demographic Forecast under the HIV/AIDS Epidemic

Underlying 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

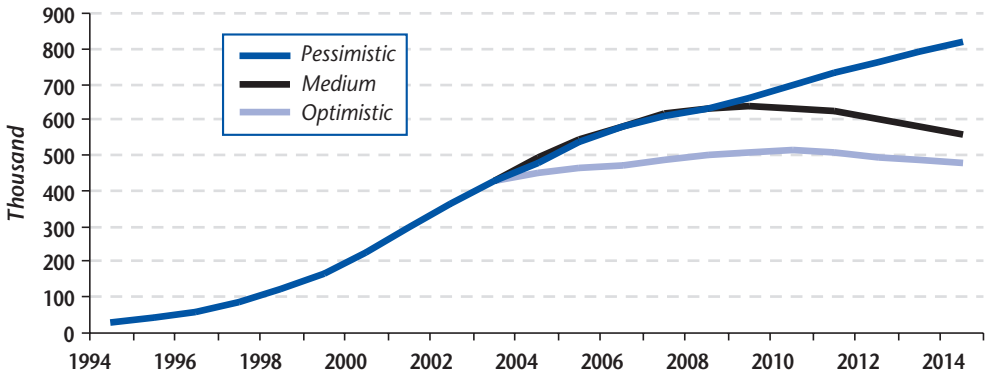
This study constructed a baseline "no-AIDS" demographic projection of the Ukrainian population until 2014 and added three HIV/AIDS epidemic scenarios (optimistic, medium, and pessimistic). The projection period is 1994-2014. These scenarios differ in their assumptions about the size and dynamics of the 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.[5]

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).[6] Figure 3-1 presents these data graphically while Annex 2 Tables A2-1 and A2-2 provide more detailed forecast results.

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



Source: Authors' calculations.

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).

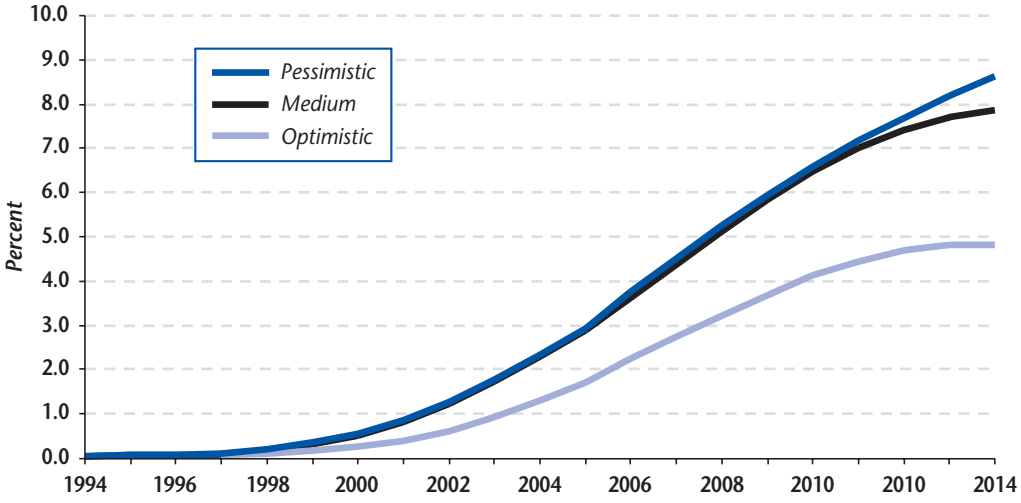
HIV's spread leads to growth in premature deaths, disability, co-infection of opportunistic diseases and TB, and reduction in life expectancy. The risk of falling sick and dying of AIDS varies by age and sex. First, AIDS victims are mainly young people, so the most significant changes will occur in the 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.

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-

[5] 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.

[6] 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



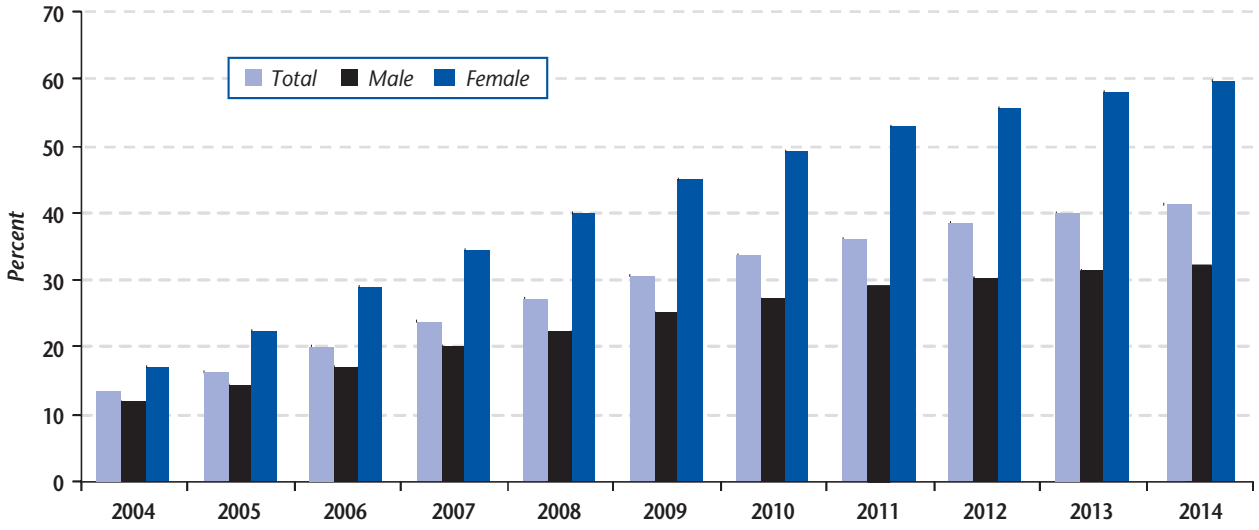
Source: Authors' calculations.

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

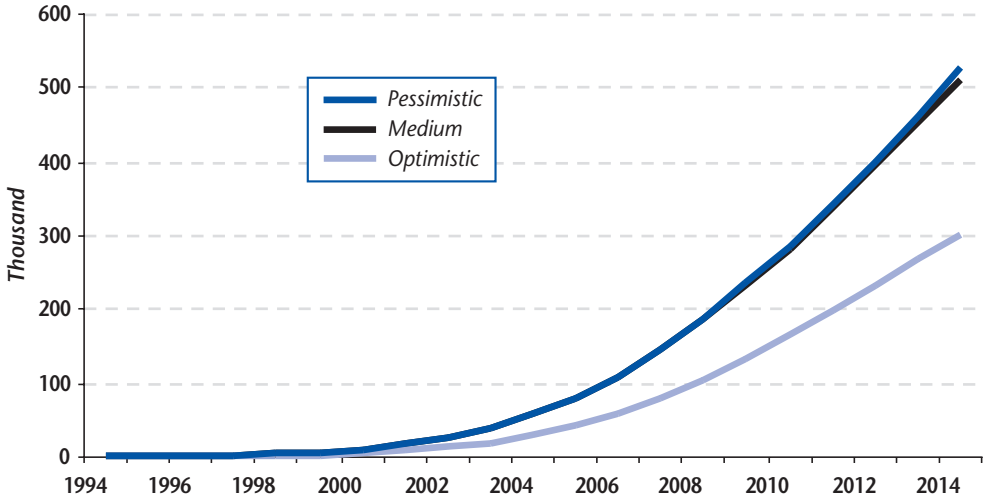
Figure 3-3. Forecasted Share of AIDS Deaths in Total Adult (15-49) Deaths, 2004-2014



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.

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



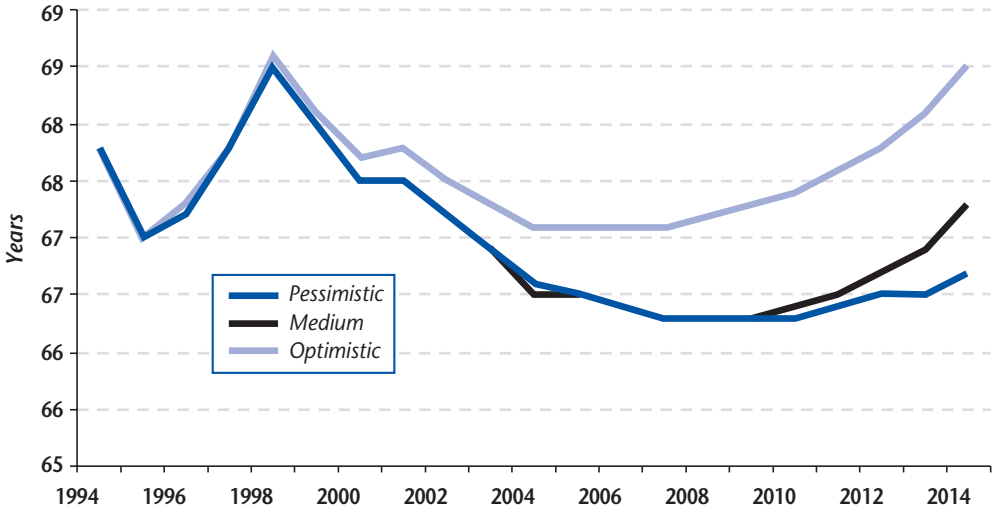
Source: Authors' calculations.

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 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).

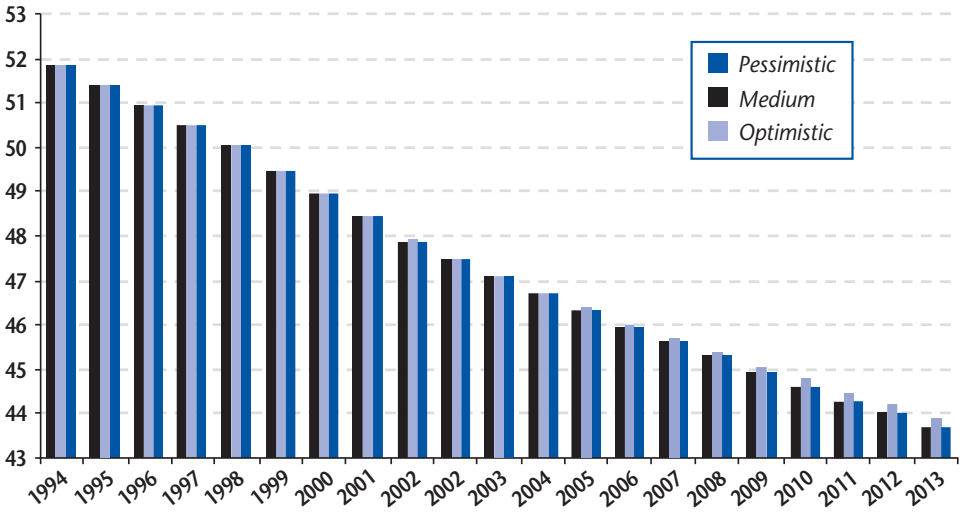
Figure 3-5. Forecasted Life Expectancy at Birth, 1994-2014, in Years



Source: Authors' calculations.

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

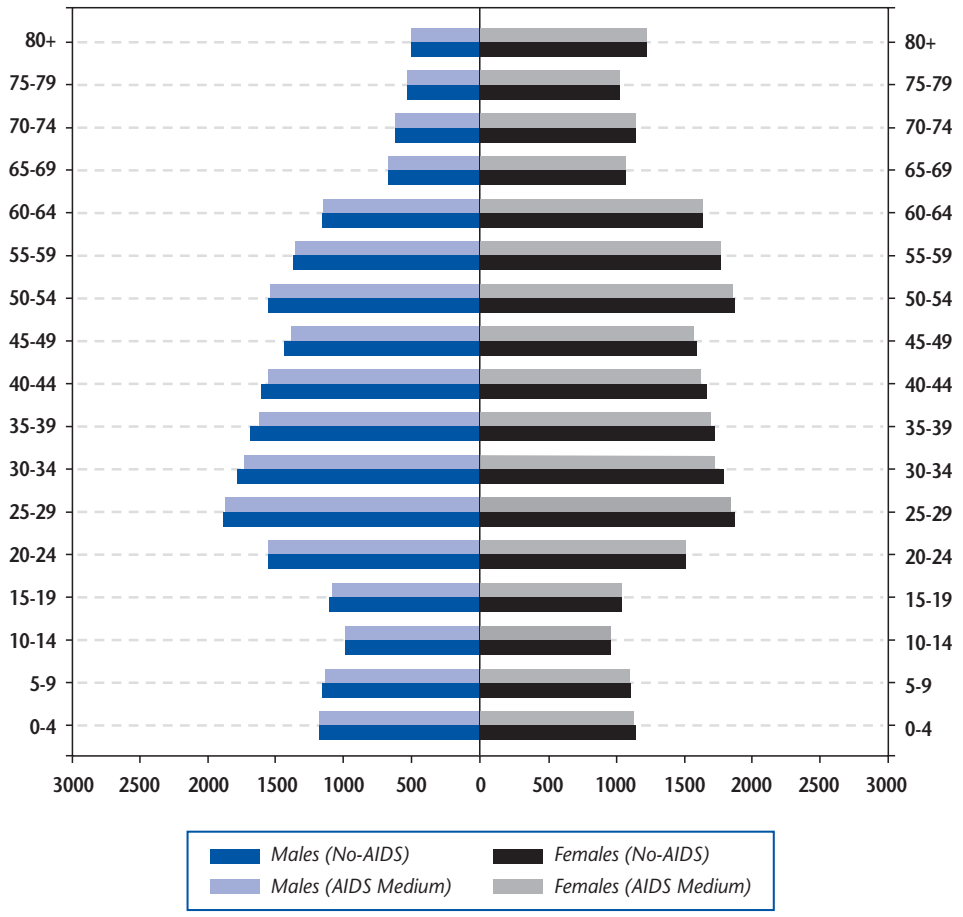
Millions



Source: Authors' calculations.

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

Thousands



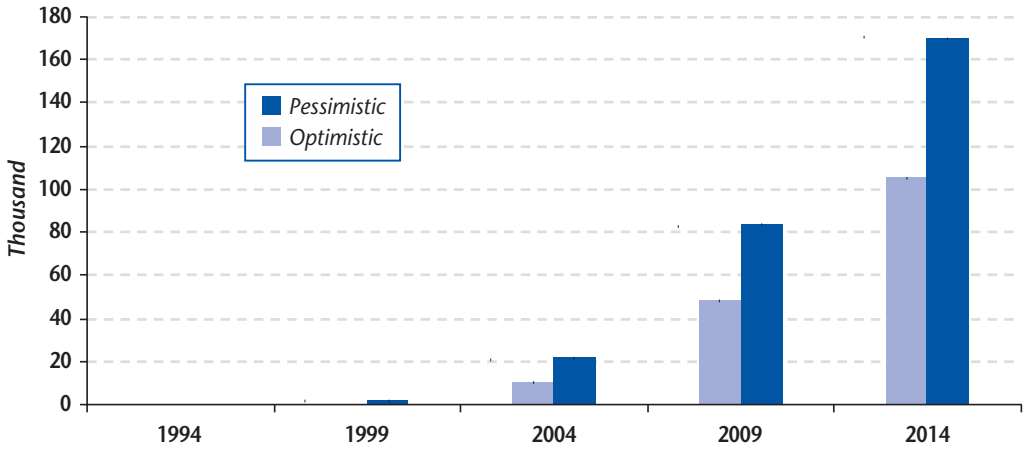
Source: Authors' calculations.

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.

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.

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 attainment 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.

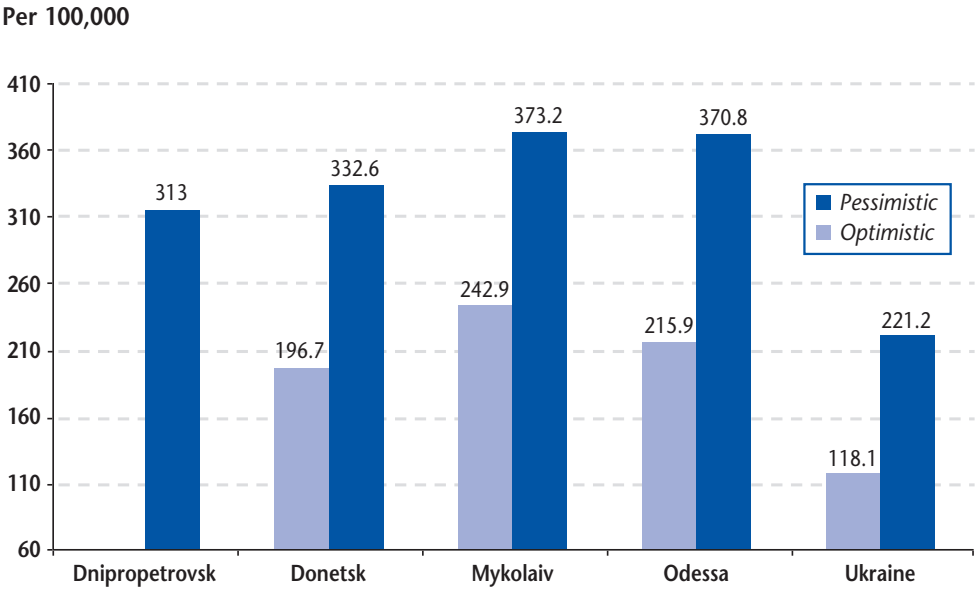
The study predicts that most of the demographic losses associated with the epidemic will accrue to these four oblasts, with a subsequent negative impact on the regional economies. The number of people infected with HIV in 2014 in these oblasts is predicted to constitute 36-43 percent of Ukraine's total 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).

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.

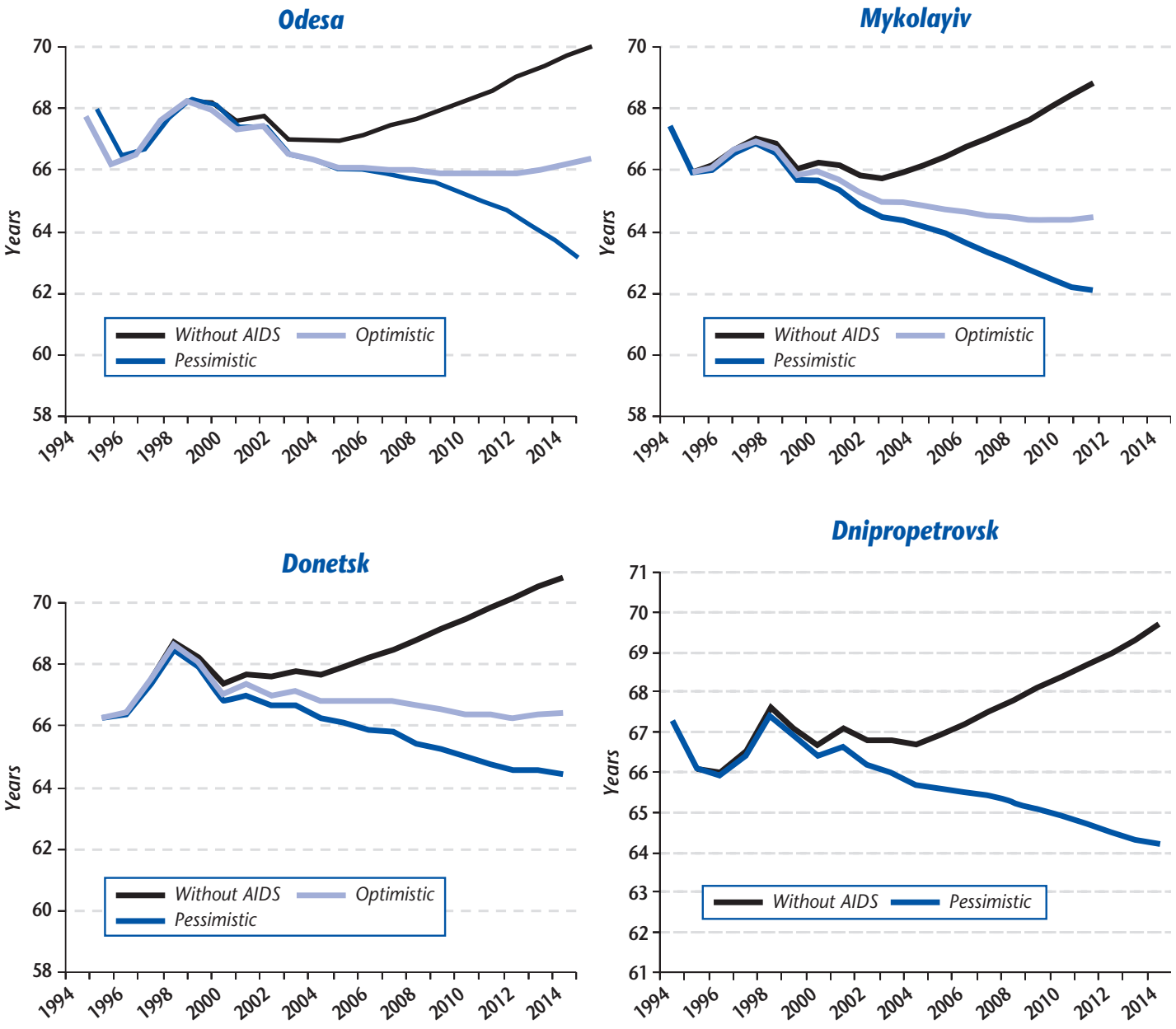
The epidemic's impact on life expectancy for four oblasts is shown in Figure 3-10 on page 18. As the HIV/AIDS epidemic continues to spread, the maximum reduction in life expectancy in the forecast period occurs in 2014, when AIDS-related mortality peaks for this period. Odesa and Mykolayiv Oblasts will 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 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.

CHAPTER 4 *Impact of the Epidemic on the Labor Force and Government Revenues*

The labor force forecast is based on the social budgeting methodology developed by Ukraine's Ministry of Labor and Social Policies/National Academy of Sciences, jointly with the United Nations Development Program (UNDP), International Labor Organization (ILO), and the World Bank. Other methodological approaches included mid- and long-term projections of demand for social services and unemployment benefits payable by the Special Fund (social insurance against unemployment). Labor projections were constructed using State Statistics Committee data for 1998-2003 on the working-age population, labor force participation (economic activity), population not in the labor force (those on aged or disability pension, full-time students, discouraged workers, etc), and employed and unemployed populations. Data were disaggregated by five-year age groups and gender. The labor force forecast relied on the demographic projections in Chapter 3 (including projections of the population aged 15-70) and macroeconomic projections for GDP, labor productivity, and average monthly wages up to 2014. A hypothetical benchmark "no-AIDS" forecast was constructed, along with three "with-AIDS" projections based on three epidemic scenarios (medium, optimistic, and pessimistic). Details are provided in Annex 3.

Table 4-1. Estimated Reduction in Selected Labor Market Indicators in the "No-AIDS" Scenario, 2004-14 (in Thousands) and Percentage of Reduction

Indicator	"No-AIDS" scenario			
	2004	*2014*	*Reduction from 2004 to 2014*	*Percentage*
Working-age population	36,173.9	33,751.9	2,422.0	6.7
Labor force	22,490.4	20,154.8	2,335.6	10.4
Employed	20,440.1	18,313.5	2,126.6	10.4
Unemployed	2,050.3	1,841.3	209.0	10.2

Source: Authors' calculations.

Analysis at the National Level

As the first step, an assumption was made for the "no-AIDS" scenario that any person aged between 15 and 70 is a working-age person who is either in or out of the labor force. The five-year age group and gender projections of the working-age population are based on actual labor force participation data for 1998-2003 and Chapter 3's demographic forecast. It is estimated that the working-age population shrinks by 2.4 million (6.7 percent) over the forecast period (2004-14). The projected labor force would decline by 2.3 million (10.4 percent) over the same period. State Statistics Committee data indicate that the labor force declined over 1998-2003 by 3.3 million (1.2 million males and 2.1 million females). The sex ratio of labor force also changed, with the share of males in the total labor force increasing from 49.2 percent in 1998 to 51.1 percent in 2003 (and a corresponding decline in the female share from 50.8 percent to 48.9 percent). This tendency is preserved over the ten-year forecast horizon, with the males' share reaching 52.3 percent. According to the forecast, total employment will decline 10.4 percent by 2014, from 20.4 million to 18.3 million. The number of unemployed decreases 10.2 percent over the period from 2.1 million to 1.8 million. Details are in Table 4-1.

Table 4-2. Estimated Reductions in Selected Labor Market Indicators due to the Epidemic, Compared to the "No-AIDS" Scenario, 2014 (in Thousands and as Percentage of Reduction)

Indicator	AIDS epidemic scenario					
	MEDIUM		OPTIMISTIC		PESSIMISTIC	
		Percentage		Percentage		Percentage
Working-age population	441.1	1.3	268.1	0.8	472.8	1.4
Labor force	323.4	1.6	193.2	1.0	351.0	1.7
Employed	286.4	1.6	170.4	1.0	301.7	1.7
Unemployed	66.1	3.6	24.9	1.4	55.2	3.0

Source: Authors' calculations.

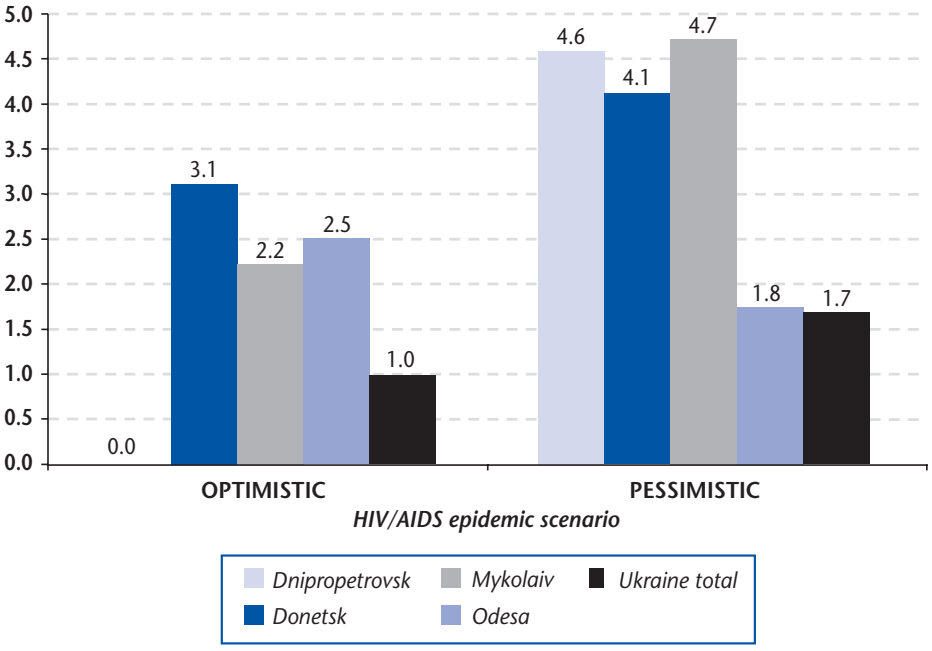
Labor Force in AIDS Epidemic Scenarios

The AIDS epidemic affects the size of a labor force significantly. Using Chapter 3's three epidemic scenarios and applying the methodology outlined in Annex 3, three projections were constructed for the working-age population, labor force, employment, and unemployment. Comparing the endpoint of projections in 2014 to the baseline "no-AIDS" value in 2014, it is estimated that in 2014 the HIV/AIDS epidemic yields an additional decline of 0.8-1.4 percent in the working-age population, a 1.0-1.7 percent decline in the labor force and employment, and 1.4-3.0 percent reduction in unemployment (see Table 4-2).

Analysis at the Regional Level

To assess the epidemic's impact on the regional level, four oblasts were selected: Donetsk, Dnipropterovsk, Odesa, and Mykolayiv. The calculations were based on the hypothetical "no-AIDS" scenario and the three epidemic scenarios. Projections were made for the working-age, economically active, employed, and unemployed populations by gender using the same methodology as in the national level analysis. Results confirm the expected reduction in the size of the working-age population and labor force, including a reduction in the employed population in all four oblasts. As Table 4-3 demonstrates, these oblasts suffer from a far stronger HIV/AIDS impact on the labor force and employment than the national average: by a factor of 2-2.5 in the pessimistic scenario. Details of the estimations are provided in Annex 3. Figure 4-1 illustrates the additional burden of HIV/AIDS on the labor force in 2014 in these oblasts compared to the national average.

Figure 4-1. Regional Comparison of Estimated Labor Force Reduction from the Epidemic, Compared to the "No-AIDS" Scenario, 2014 (Percentage of Reduction)



Source: Authors' calculations.

Impact of Epidemic on Government Budget Position and Special Social Protection Funds

The study estimated forgone revenue to the state and special funds (including pension and social insurance funds covering temporary disability, unemployment, and social protection of those with permanent disabilities) caused by

Table 4-3. Regional Comparison of Estimated Losses from the Epidemic in Selected Labor Market Indicators, Compared to the "No-AIDS" Scenario, 2014 (Percentage of Reduction)

Percentage decline compared to "no-AIDS" 2014 baseline in:	**Working-age population**		**Labor force**		**Employed**		**Unemployed**	
	Optimistic	*Pessimistic*	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*
Dnipropetrovsk	NA	2.5	NA	4.6	NA	4.6	NA	4.6
Donetsk	1.3	2.2	3.1	4.1	3.1	4.1	3.1	4.1
Mykolaiv	1.2	1.2	2.2	4.7	1.1	3.6	9.2	11.6
Odesa	1.2	1.8	2.5	1.8	4.8	4.8	6.6	6.6
Ukraine total	**0.8**	**1.4**	**1.0**	**1.7**	**1.0**	**1.7**	**1.4**	**3.0**

Note: "NA" = not available: no optimistic scenario was constructed for Dnipropetrovsk due to lack of data.

Source: Authors' calculations.

the epidemic. Such forgone revenue results from a reduction in the number of people employed and an increase in the number who cannot work due to illness. See Annex 4 for methodology, definitions, assumptions, and results from this section.

Revenue forgone through unpaid taxes and levies due to the reduction in employment was estimated using two epidemic scenarios: optimistic and pessimistic. Using the projected reduction in employment, forgone state revenues are calculated as the amount of unpaid personal income tax; forgone pension fund contributions (unpaid fees for mandatory state pension insurance); forgone revenue to the disability social insurance fund (unpaid premiums to the fund); and forgone revenue to the unemployment social insurance fund (unpaid levies to this fund), respectively.

Using the estimates of reduction in employment, the average withholding rate, and the average monthly wages, the study calculates the annual forgone revenue to the state and special funds to be between 263.8 million and 418.8 million UHA (optimistic-pessimistic scenario), or 0.13-0.21 percent of the total.

On the expenditure side, direct budgetary costs take the form of permanent disability pensions from the pension fund for those who progress to AIDS, additional financial assistance from the social protection fund (SPF) for those disabled by AIDS, temporary disability payments from the same fund for those infected with HIV and progressing to AIDS, and state assistance to children with HIV/AIDS.

This analysis assumes that everyone who develops AIDS becomes permanently disabled and eligible for a disability pension and related additional benefits. Based on the projected number of AIDS cases for 2004-14 and a range of assumptions for calculating the corresponding disability benefits (Annex 4), the estimated additional annual expenditure by the pension fund for permanent disability pensions to those who develop AIDS will reach 109.2-200.0 million UHA (optimistic-pessimistic) by 2014. The corresponding average growth rate of AIDS-related outlays from the pension fund is 13-15 percent per year (optimistic-pessimistic scenarios). The total additional annual expenditure from the SPF related to permanent disability from AIDS is estimated to reach 19.5-35.5 million UHA by 2014 (optimistic-pessimistic), a 3-7 percent increase in total outlays from these funds. Adding the guaranteed minimum pension to children with HIV/AIDS yields an additional 3.5-8.3 million UHA payment from the SPF.

Before developing full-blown AIDS, those infected with HIV become progressively ill, requiring sick leave from work, which is funded by a social protection (temporary disability) fund. Overall, 524,000 persons in the optimistic and 721,100 persons in the pessimistic scenarios will receive temporary

disability benefit over 2004-14. This translates into an additional annual outlay of UAH 6.8-11.5 million by 2014 (Annex 4).

Table 4-4 lists these calculations, providing estimates of total non-medical annual state costs associated with social protection and pensions for HIV/AIDS victims, plus the forgone revenue, at UHA 402.8-673.0 million, depending on the epidemic scenario. Health expenditure associated with HIV/AIDS is estimated in Chapter 5.

Table 4-4. Total Additional Annual Non-medical Budgetary Losses/Costs Associated with HIV/AIDS, 2014

In 100,000 UAH

Category	Optimistic	Pessimistic
Forgone revenue	***263.8***	***418.6***
Expenditures		
Pension fund: Permanent disability due to AIDS	109.2	200.0
Additional assistance to permanently disabled (SPF)	19.5	35.5
Temporary HIV disability payments (SPF)	6.8	11.5
Assistance to children with HIV/AIDS	3.5	8.3
Total additional expenditures	***139.0***	***255.3***
Total budgetary costs	**402.8**	**673.9**

Source: Authors' calculations.

CHAPTER 5 Estimating the Macroeconomic Costs of the HIV/AIDS Epidemic

This study applied various macroeconomic models to estimate the costs of HIV/AIDS in Ukraine, building on similar work done in Ukraine and Russia. The purpose is to use the most recent available data and methodology to provide a plausible range for the magnitude of the impact of the epidemic.

The literature on the macroeconomic costs of HIV/AIDS is large and continuously expanding.[7] Among the analytical tools used for modelling are a neoclassical growth model[8] (based on the aggregated variables, such a model necessarily misses microeconomic effects on heterogeneous households), various types of computable general equilibrium (CGE) macroeconomic models,[9] and macroeconometric models.[10] As a rule, data requirements rise with the complexity of the model.[11] Incorporating a mechanism for disease transmission and modelling its effects adds another layer of complexity.

Several studies of the economic costs of HIV/AIDS have been conducted in the Russian Federation. Similar to Ukraine, Russia has experienced one of the world's fastest growing epidemics over the past five years (according to the UNAIDS 2003 estimate, 860,000 infected or 1.1 percent adult (15-49) prevalence). Its apparent shift from an IDU-driven to a generalized epidemic is similar to that of Ukraine.
A World Bank team has developed a simple growth model (Ruehl, Pokrovsky, and Vinogradov [2002]). UNDP developed a 35-sector CGE model based on Russian input-output tables (UNDP [2004] and Sharp [2004b]). The International Labor Organization (ILO) has developed a model that combines an infection probability profile with a partial equilibrium economic model to assess the impact of HIV/AIDS on population, labor force, sustainability of the pension fund, costs of short-term disability benefit, health care

7 International literature on modeling the economic impacts of HIV/AIDS has been thoroughly summarized and reviewed in Haacker (2004b). Cross-sectional estimations are reported in Over (2002), Cuddington (1993a and b), Cuddington, Hancock, and Rogers (1994), and Cuddington and Hancock (1994), among others. A one-sector growth model with two types of labor, an exogenous saving rate, and a closed-economy assumption is discussed in Haacker (2004a). Open economy with perfect capital mobility is modelled in Freire (2004). Haacker (2002a) studies the effects of HIV/AIDS on the public sector and on economic growth in both closed- and open-economy settings. A model covering the informal sector is proposed in Haacker (2002b). Intertemporally optimizing consumers investing in human capital with the presence of AIDS is considered in Bell, Devarajan, and Gersbach (2004). Arndt and Lewis (2001) examine implications of the HIV/AIDS epidemic in South Africa for sectoral employment and economic growth using a computable general equilibrium (CGE) model. An overlapping generations (OLG) framework with human capital is used. Studies of the impact of intervention strategies on the dynamics of the epidemic include Lewis (1989), IUSSP (1993), Kaplan and Brandeau (1994), and FitzSimons, Hardy, and Tolley (1995). The experience of developing countries battling the epidemic, including prevention policies, socioeconomic determinants of the epidemic, and AIDS' direct impact on the health sector and households, is discussed in Ainsworth, Fransen, and Over (1998).

8 A neoclassical growth model can be either aggregated (one-sector, two-factor) or disaggregated by type of labor (skilled/unskilled) and/or by sector. Open- and closed-economy assumptions yield different results. Haacker (2004a) demonstrates that a perfect capital mobility assumption yields more negative per capita effect and highlights shortcomings of an aggregate approach in modelling the economic impact of AIDS.

9 CGE models contain behavioral equations for consumers/firms derived from the microeconomic optimization theory and can be either comparative static or dynamic (the latter are based on the intertemporal optimization or are recursive dynamic). There are single and multi-country models developed for various analytical purposes, all with varying degreea of sectoral disaggregation. They are formulated in either a representative consumer or an OLG framework. Financial assets may or may not be included in the model.

10 Based on aggregate economic theory and a time series analysis technique, macroeconometric models often lack theoretical structure. Econometric estimation often proves to be technically challenging in transition and developing-economy settings.

11 Econometric estimates of core model parameters (such as elasticities of substitution in consumption and production input bundles) need to be obtained for CGE models. Multi-sectoral models require input-output tables often unavailable in developing and transition countries.

expenditures for employees, and changes of employment on GDP (ILO [2004], reported in Sharp [2004a]).

Barnett et al. (2001), in work funded by the U.K. Department for International Development and The British Council, evaluated the epidemic's social and economic impact in Ukraine. It is the most widely cited study to date used successfully for policy advocacy. Since the epidemic situation has been changing rapidly since 2001, and new data have become available, the AIDS research and policy community need a re-evaluation of that study. Modeling also needed to be extended to capture the epidemic's macroeconomic effects using the recently available methodology.

Given the degree of uncertainty about the magnitude of the epidemic and its impacts on the factors of production and economic parameters, this study attempted to apply several models for the analyses. Comparing model implications establishes a plausible range for the magnitude of the effects. Lack of data on the costing and effectiveness of many preventive programs (harm reduction, sex education, and condom distribution) limited this study to a projection of the impact of prevention and treatment to ART while acknowledging that other measures are also important and can have significant socioeconomic impact. To ensure comparability of the results, all three models use the same inputs generated by demographic and epidemiological forecasting module and the same scenarios with respect to the costs of treatment and ART. A simple growth model, a macroeconometric model, and a CGE model were all applied to evaluate the macroeconomic costs of HIV/AIDS in Ukraine. Both macroeconometric and CGE models are multisectoral, allowing us to study the differential effects of the epidemic on various sectors of the economy. While different in theoretical structure, both models demonstrate strong sectoral effects.

Simple Growth Model

This section analyzes the application of a simple growth model based on a hypothetical baseline "no-AIDS" scenario and two of the epidemic scenarios (optimistic and pessimistic) constructed in Chapter 3.[12] Three scenarios with respect to the cost of ART, the level of hospitalization of AIDS patients, and the cost/coverage of hospitalization are considered: scenario A is "ARV-low, HOSP(italization)-low"; scenario B is "ARV-high, HOSP-low"; and scenario C is "ARV-high, HOSP-high." Detailed descriptions of the scenario assumptions, methodological approach, data inputs, and model results are in Annex 5. In this section, the optimistic scenario builds on the possible policy intervention that extends availability of ART to a greater number, compared to the pessimistic scenario. It also assumes that the measures of the Ukrainian National Program to Fight HIV/AIDS are successfully implemented, with a corresponding reduction in the rates of MTCT, etc. By calculating the number of avoided new HIV cases and using the Ukrainian cohort life expectancies, the Disability Adjusted Life Years (DALYs) prevented through the intervention are calculated and discussed.

Model Results

Cost scenario A, ARV-low, HOSP-low, would result in the following compared to the baseline in 2014:

- Reduction in the level of output in constant prices by 0.7 percent (optimistic scenario) and 1.3 percent (pessimistic),
- Per capita output unchanged,
- Reduction in average GDP growth rate over 2004-14 of 0.06 percent (optimistic) and 0.11 percent (pessimistic),
- Reduction in capital stock by 0.2 percent (optimistic) and 0.3 percent (pessimistic),
- Reduction in labor supply by 1 percent (optimistic) and 1.5 percent (pessimistic), and
- Reduction in investment by 0.7 percent (optimistic) and 1.3 percent (pessimistic).

[12] Epidemic scenarios differ in their assumptions about the size and dynamics of the most-at-risk populations, yielding different estimates of adult prevalence rates. In our optimistic scenario, adult HIV prevalence rate peaks at 2% in 2010 and in the pessimistic one at 3.5% in 2014. Reduction in the vertical transmission rate (15.9% in 2003) is faster in the optimistic scenario (to 10% in 2004 and then to 5% in 2014) than in the pessimistic one (gradual reduction to 10% in 2014). Availability of ART to those who need it increases from 1% in 2004, to 30% in 2010, and further to 50% in 2014 in the optimistic scenario and to 5% in 2005 and holding at that level until 2014 in the pessimistic one.

The order of effects generated by the model is modest. Scenarios B and C with respect to the cost of ARV therapy and hospital treatment have only marginal effect on the macroeconomic variables (see Annex 5 Table A5-2).

Total AIDS-related medical expenditure is higher in the optimistic scenario compared to the pessimistic one, reaching an annual amount of UAH 628 million by 2014. More than 56 percent of the 2014 total medical expenditure in the optimistic scenario is devoted to ART. This contrasts to a less than 10 percent share of ART in the pessimistic case, where most of the budget is allocated to hospital care. In both cases, HIV/AIDS-related costs represent about 4 percent of the MOH budget. At the same time, mortality and morbidity outcomes in the pessimistic scenario are significantly worse compared to the optimistic scenario: in the former, the total number of infections, the adult prevalence rate, and the number of those needing ART exceed those in the optimistic scenario by a factor of 1.7-1.8, the number of new AIDS cases and annual AIDS deaths by a factor of 1.8-1.9, and the number of new annual HIV infections and annual births to HIV-positive mothers by a factor of 3.2-3.7 (see Tables 5-1 and 5-2).

Table 5-1. Estimated Annual Medical Expenditure Associated with HIV/AIDS Prevention and Treatment in 2014

100,000 UAH

Medical expenditure, including:	Optimistic	Pessimistic
ART	353.0	51.9
AIDS care	275.8	504.5
Total medical expenditure	628.8	556.4
Medical expenditure as a percentage of MOH budget	4.19 percent	3.71 percent

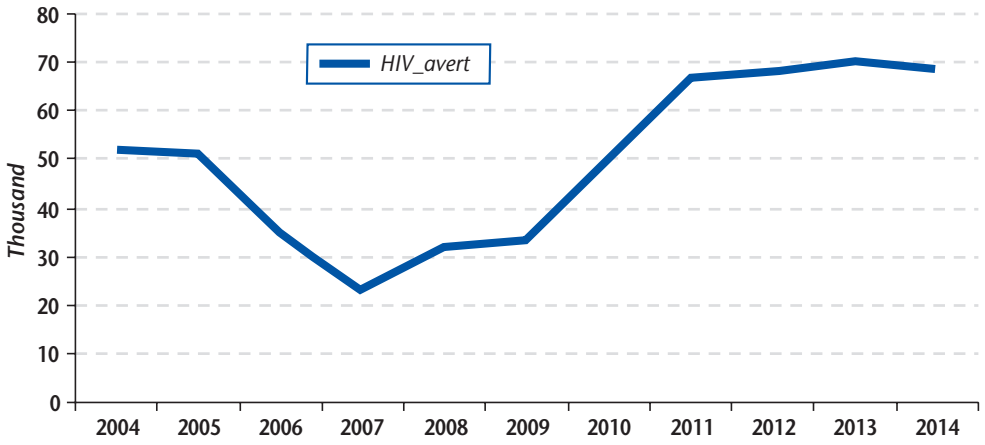
Source: Authors' calculations.

Table 5-2. Projected Epidemic Outcomes, 2014, Scenario Analysis

HIV/AIDS Summary: 2014	*Optimistic*	*Pessimistic*	*Ratio (pessimistic to optimistic)*
Number infected with HIV, thousands	478.5	820.4	1.71
Adult prevalence rate, percentage	2.0	3.5	1.76
New annual HIV infections, thousands	29.0	94.0	3.24
Cumulative number needing ARV treatment, thousands	94.0	155.0	1.65
New annual AIDS cases, thousands	36.8	67.3	1.83
Annual HIV+ births, thousands	0.5	1.7	3.69
Annual AIDS deaths, thousands	34.8	64.9	1.86
Annual AIDS deaths per thousand	0.8	1.5	1.89
Cumulative AIDS deaths, thousands	301.3	526.4	1.75
AIDS orphans, thousands			
Dual	26.0	42.0	1.62
All	105.0	169.0	1.61
Life expectancy, years			
Total	68.5	66.7	0.97
Male	63.4	61.6	0.97
Female	72.9	71.0	0.97
Population, hundred thousands	43.9	43.7	0.99

Source: Authors' calculations.

Figure 5-1. Number of HIV Infections Averted by Realizing "AIDS Optimistic" Rather Than "AIDS Pessimistic" Scenario, 2004-14



Source: Authors' calculations.

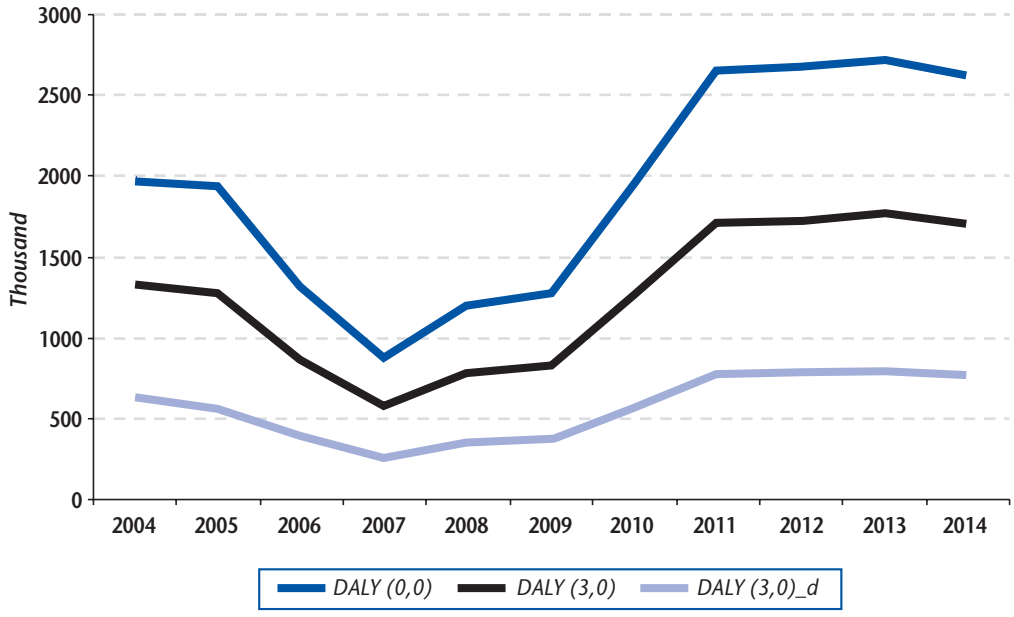
Analysis of Optimistic versus Pessimistic Epidemic Scenarios as a Policy Intervention

The incidence-based methodology for the economic evaluation of the HIV intervention programs used in this study follows the methodology of the Global Burden of Disease (GBD) study (see Murray, Lopez, and WHO [1994]; Murray and Acharya [1997]; Murray et al. [2000]; and Murray and Lopez [2000]) and uses the Disability Adjusted Life Year (DALY) measure. See Annex 6 for detailed discussion of the GBD methodology.

The underlying pessimistic and optimistic epidemiological scenarios rest on an assumption about the availability of ART. The study assumes 100 percent public financing of the therapy and examines the cost-effectiveness of such a policy intervention measured in public expenditure per DALY saved/avoided.

To construct the DALY measure, the number of new HIV cases avoided each year was predicted for 2004-14 based on the Spectrum AIM projections. The cases avoided were recorded by age-sex group for each year. As Figure 5-1 demonstrates, extension of ART to 50 percent of those in need (optimistic), compared to 10 percent (pessimistic) by 2014, would prevent 50,000 new HIV infections per year on average over 2004-14.

Figure 5-2. Number of DALYs Averted by Realizing "AIDS Optimistic" Rather Than "AIDS Pessimistic" Scenario, 2004-14



Source: Authors' calculations.

Note: See footnote on page 27 for legend description.

For each prevented case, the Years of Life Lost (YLL) was calculated based on the cohort life expectancy, and the Years Lost to Disability (YLD) was calculated based on the assumptions about the duration of the disease and its severity, presented in Annex 6 Table A6-1. It is assumed that on average, a child develops full-blown AIDS in 6 years and dies in 7 years and 3.5 months. An adult develops AIDS within 8 years and dies in 12.4 years. Based on the disability weights from Annex 6 Table A6-1, DALYs averted were calculated for 2004-14, with three

measures constructed.[13] Results are presented in Figure 5-2.

Depending on the measure used, in excess of 21 million undiscounted DALYs (13.8 million DALYs discounted at 3 percent) would be saved over 2004-14 if the optimistic scenario is followed instead of the pessimistic one. In low-cost scenario A, this would be achieved at an average cost of 11-37 UHA per DALY (depending on whether an undiscounted or a discounted DALY measure is used), which translates into a total average health expenditure of 9-29 UHA per DALY after taking into account the corresponding reduction in AIDS hospitalization costs. The average annual cost per averted HIV infection is 419 UHA (or 328 UHA net of avoided hospitalization costs). The high-cost scenario C generates an average cost of 54-184 UHA per DALY (depending on definition), which translates into the total average health expenditure of 17-57 UHA per DALY (after accounting for avoided hospitalization costs). The average annual cost, net of avoided hospitalization costs, per averted HIV infection in the high-cost scenario is 762 UHA. Provision of ART appears to be a highly cost-effective intervention in this hypothetical comparative analysis of optimistic and pessimistic scenarios. Details of the results are in Annex 6 Table A6-3.

Macroeconomic Model

In this section, a macroeconometric model is used to evaluate the economic costs of Ukraine's epidemic, using the labor force projections from our epidemic scenarios. The impact of HIV/AIDS on sectoral employment during 2004-14 is estimated and used as an input into the macroeconometric model. The methodology for model estimation and application is discussed in Annex 7.

Predicted decline in the level of GDP depends on the measure of GDP used (product or expenditure). GDP (production) shortfall is larger due to the direct impact of reduced employment (a reduction of 1.6-3.0 percent by 2014). GDP (expenditure) measured though the basic macroeconomic identity falls by 1.4-2.7 percent in the range of epidemic scenarios. Gross investment falls by 1.5-2.8 percent compared to the benchmark, and budget revenue declines by 1.3-2.6 percent by 2014, depending on the epidemic scenario. The estimations show only slight decreases in savings, imports, and average labor productivity (output per employee).

Sectoral Analysis

The model allowed us to estimate value-added in separate sectors of economic activity (in constant 1996 prices) for the following sectors: agriculture, hunting, forestry and fishing industry; mining; manufacturing; production and distribution of electricity, gas, and water (EGW); construction; wholesale and retail trade, trade in transport facilities and repair services; transport and communications; financial services; real estate operations, leasing and services to legal entities; government services; health and social services; education; and other services. The epidemic's estimated impacts on these sectors are presented in Table 5-3 on page 28.

As follows from Table 5-3, the agriculture, hunting, forestry, and fishing industry is the most affected (a decline of 1.2-2.3 percent compared to the "no-AIDS" scenario in 2014), followed by transport and communications (a reduction of 1.2-2.2 percent), and construction (minus 1-1.8 percent). The gap between sectoral outputs in "no-AIDS" and "with-AIDS" scenarios widens as the epidemic unfolds.

The results for agriculture are explained by the fact that the regions worst affected by HIV/AIDS produce almost 80 percent of Ukraine's total agricultural output. Losses in the labor force and a high estimated labor intensity in the agricultural production function lead to an overall strong sectoral effect. Annex 7 Table A7-3 ranks the oblasts with regard to major agricultural producers in terms of the HIV prevalence in 2004, with 1 corresponding to the lowest prevalence rate and 5 the highest. Most agricultural employment is located in the areas with a relatively high HIV prevalence. Due to the unavailability of rural/urban prevalence data, this was the best feasi-

[13] Three measures are DALY (0,0), undiscounted; DALY (3,0), discounted at 3 percent; and DALY (3,0)_d (discounted), with YLL discounted back from the time of death to the time of infection.

Table 5-3. Macroeconometric Model: Estimated Difference in Sectoral Output in Two Epidemic Scenarios, 2005-14

Percentage difference from "no-AIDS" scenario	2005	2014	2005	2014
	OPTIMISTIC		PESSMISTIC	
All sectors	-0.35	-0.90	-0.31	-1.73
Agriculture, hunting, forestry, & fishing	-0.29	-1.20	-0.26	-2.31
Mining	-0.03	-0.10	-0.03	-0.19
Manufacturing	-0.09	-0.23	-0.08	-0.43
EGW	-0.07	-0.20	-0.06	-0.38
Construction	-0.26	-0.95	-0.23	-1.83
Wholesale & retail trade	-0.05	0.16	-0.05	-0.31
Transport & communications	-0.27	-1.17	-0.23	-2.24
Financial services	-0.05	-0.23	-0.05	-0.44
Real estate	-0.03	-0.08	-0.03	-0.16
Government services	-0.09	-0.41	-0.08	-0.79
Health & social services	-0.03	-0.11	-0.03	-0.20
Education	-0.19	-0.67	-0.16	-1.29
Other services	-0.11	-0.22	-0.10	-0.43

Source: Authors' calculations.

ble way to estimate the effect of HIV/AIDS on agricultural labor. The magnitude of the effect is explained by the particular form of the estimated production function.

State Statistics Committee of Ukraine (Derzhkomstat 2004a) data indicate that the worst-affected oblasts in terms of the HIV prevalence are the ones with the highest output per worker and the highest agricultural wages that drive inward migration. Table A7-4 reports nominal wages by oblast, confirming that Dnipropetrovsk, Donetsk, Zaporizhya, Kyiv, Lugansk, Odesa, and Kharkiv Oblasts report wages significantly above the national average. All of these oblasts are at or above the national HIV prevalence rate.

Multisector CGE Model

A 20-sector computable general equilibrium (CGE) model was also developed and applied to study the epidemic's macroeconomic effects. Model description, methodology, and results are in Annex 8. Based on the general methodological approaches discussed above (e.g., Sharp [2002]; Ruehl, Pokrovsky, and Vinogradov [2002], and Haacker [2004 a and b]), the impact of HIV/AIDS on the economy was modeled as three distinct shocks, as follows:

Reduction in labor supply. A 1.5 percent, 2 percent, and 4 percent decline in labor force endowment is assumed for optimistic, medium, and pessimistic scenarios, respectively, based on the labor force projections of Chapter 4. The most pessimistic scenario in terms of labor supply shock is based on the projected magnitude of labor force decline in the most-affected regions. See Annex 8 for details on the distribution of shocks by type of labor.

Reduction in labor productivity. The study assumed a 1.5 percent, 4 percent, and 7 percent reduction in labor productivity in optimistic, medium, and pessimistic scenarios, respectively. Changes in labor productivity were modeled through the Total Factor Productivity (TFP) score, distributed according to the factor shares by type of labor (using Annex 8 Tables A8-1 and A8-2).

Increase in public spending. Based on the epidemic and cost scenario projections provided earlier, the public expenditure related to HIV/AIDS will increase within the range 0.2 percent, 2 percent, and 3.5 percent of the government budget, for the optimistic, medium, and pessimistic scenarios, respectively.

Based on these types of shocks, three scenarios were applied. One scenario (Scenario 2 or "Medium") has three subscenarios within it, referred to here as scenarios 4-6 and listed in the tables under "Medium subscenarios."

- **Scenario 1:** Optimistic: 1) drop in labor supply of 1.5 percent; 2) decrease in labor productivity of 1.5 percent; and 3) increase in public spending by 0.2 percent;

- **Scenario 2:** Medium: 1) drop in labor supply of 2.0 percent; 2) decrease in labor productivity of 4.0 percent; and 3) increase in public spending by 2.0 percent;
- **Scenario 3:** Pessimistic: 1) drop in labor supply of 4.0 percent; 2) decrease in labor productivity of 7.0 percent; and 3) increase in public spending by 3.5 percent;
- **Scenario 4:** Drop in labor supply of 2.0 percent;
- **Scenario 5:** Decrease in labor productivity of 4.0 percent;
- **Scenario 6:** Increase in public spending of 2.0 percent.

Scenarios 4-6 were used to evaluate the relative importance of the underlying shocks in generating the overall effect.

Estimated Macroeconomic Implications

Table 5-4 documents the negative impact of HIV/AIDS across all scenarios. Total welfare and GDP substantially decrease under all six scenarios, including those with single shocks, and the gap

Table 5-4. CGE Model: Macroeconomic Implications of the Epidemic, Scenario Analysis

MACRO INDICATORS		Scenarios			Medium subscenarios		
	Benchmark	*Pess-c*	*Med-m*	*Opt-c*	*Reduced labor*	*Lower TFP*	*Higher public spending*
Welfare (equivalent variation, change in percentage)	-	-8.3	-4.6	-2.2	-2.6	-3.3	0.0
GDP Index (change in percentage)	-	-5.5	-3.1	-1.6	-1.8	-2.3	0.2
Private investment (change in percentage)		-9.0	-5.0	-2.4	-2.8	-3.6	0.0
Real factor return (change in percentage)							
– Return to capital	-	-7.03	-3.87	-1.90	-2.22	-2.55	-0.11
– Wage rate for unskilled labor	-	-7.46	-4.17	-1.78	-1.93	-3.55	-0.03
– Wage rate for skilled labor	-	-2.58	-1.70	0.07	0.55	-3.56	0.05
– Wage rate for highly skilled labor	-	-1.42	-1.05	0.37	0.89	-3.18	0.14
Aggregate exports (UAH billion)	113.24	102.54	107.12	110.40	110.05	108.52	113.18
Aggregate imports (UAH billion)	109.92	99.09	103.74	107.05	106.69	105.18	109.84
Total exports (change in percentage)	-	-9.46	-5.41	-2.51	-2.82	-4.17	-0.06
Total imports (change in percentage)	-	-9.86	-5.63	-2.61	-2.94	-4.31	-0.08
Tariff revenue (share of public budget)	10 %	9 %	9 %	10 %	10 %	10 %	10%
Indirect tax revenue (share of public budget)	49 %	55 %	52 %	51 %	51 %	51 %	50%
Indirect tax rate (weighted average)	12 %	15 %	13 %	12 %	12 %	12 %	12%
Consumer Price Index (change in percentage)	-	-0.75	-0.42	-0.18	-0.20	-0.34	-0.01
Producer Price Index (change in percentage)	-	-3.01	-1.59	-0.66	-0.77	-0.90	-0.29
Real exchange rate (change in percentage)	-	-1.60	-0.77	-0.34	-0.43	-0.25	-0.19

Source: Authors' calculations.

widens from optimistic to pessimistic scenarios. Increased expenditure on care and treatment raises public and private consumption and decreases savings and investments. Private investment falls by 9 percent in the pessimistic scenario, following the 7 percent reduction in real rate of return to capital. The latter is due to the reduced marginal product of capital following the loss of labor.

The reduction in labor productivity (modeled as a shock to TFP) is the strongest driver of the negative impact, followed by the reduction in labor supply. Increased public spending yields a smaller effect. Return to labor (wages) declines in all scenarios except the optimistic one. Separating out the effects of reduced labor supply and lower productivity, we find that as skilled and highly skilled labor becomes scarcer, their factor payment (wages) goes up. Nevertheless, the labor productivity factors act in the opposite direction, pushing wages down, and the combined effect is a fall in wages. Note from Table 5-4 that both exports and imports fall, driven by the changes in domestic supply and demand.

Table 5-5. CGE Model: Sectoral Implications of HIV/AIDS Epidemic, Scenario Analysis

OUTPUT INDEX		Scenarios			Medium subscenarios		
	Benchmark	*Pess-c*	*Med-m*	*Opt-c*	*Reduced labor*	*Lower TFP*	*Higher public spending*
Agriculture, hunting	1.00	1.02	1.01	1.00	1.00	1.01	1.00
Fishery	1.00	0.99	1.00	1.00	0.99	1.00	1.00
Mining of coal and peat	1.00	0.91	0.95	0.98	0.97	0.97	1.00
Production of non-energy materials	1.00	0.67	0.81	0.91	0.91	0.84	1.00
Food-processing industries	1.00	0.98	0.99	1.00	0.99	1.00	1.00
Textile and leather industry	1.00	0.99	1.02	1.01	1.01	1.05	0.98
Woodworking, pulp and paper industry, publishing	1.00	1.03	1.03	1.01	1.00	1.04	1.00
Petroleum refinement	1.00	0.95	0.97	0.99	0.99	0.98	1.00
Manufacture of chemicals, rubber and plastic products	1.00	0.89	0.95	0.98	0.98	0.96	1.00
Manufacture of other non-metallic products	1.00	0.90	0.95	0.98	0.97	0.97	1.00
Metallurgy and metal processing	1.00	0.63	0.78	0.91	0.90	0.81	1.00
Manufacture of machinery and equipment	1.00	0.91	0.96	0.97	0.97	0.99	1.01
Other	1.00	0.74	0.84	0.93	0.93	0.86	1.00
Electric energy	1.00	0.90	0.95	0.98	0.97	0.96	1.00
Public utilities	1.00	0.94	0.97	0.98	0.98	0.98	1.00
Construction	1.00	0.93	0.96	0.98	0.98	0.98	1.00
Trade	1.00	0.94	0.97	0.98	0.98	0.98	1.00
Hotels and restaurants	1.00	1.21	1.12	1.04	1.04	1.12	1.00
Transport	1.00	1.20	1.11	1.04	1.04	1.10	1.00
Post and telecommunications	1.00	1.01	1.01	1.00	1.00	1.02	1.00
Other services	1.00	1.00	1.00	1.00	0.99	1.01	1.00

Note: All benchmark indexes equal unity (or 100 percent), reflecting the starting (benchmark) position for the change.

Source: Authors' calculations.

Sectoral Implications

The HIV/AIDS epidemic is estimated to have important sectoral impacts, depending on the factor intensity of the sector and the distribution of skill classes within the sector labor force (see Table 5-5). Sectors with labor-intensive production and a high share of skilled and highly skilled labor appear to be the most affected. Examples include the mining of coal and peat and production of non-energy materials sectors (the share of skilled and highly skilled is about 44 percent in each). Separate simulations under the medium scenario reveal that decline in labor supply and labor productivity has a relatively equal impact on sector output, given a slightly higher weight on labor productivity in some sectors. Similar results are observed for sectoral exports (see Annex 8 Table A8-5).

CHAPTER 6 Policy Implications and Conclusions

Our findings after assessing the short- to medium-term (2004-14) socioeconomic impact of the HIV/AIDS epidemic in Ukraine demonstrate that if not curtailed, the spread of this disease is likely to have grave effects on the population and economy. Allowed to grow at its current rate, the epidemic will have a long-lasting and destructive effect not only at the individual level but to the society at large. AIDS has become a reality of life in many countries, impeding human development, limiting the rights of children and adults to healthy and productive lives, and affecting living standards. As this study shows, Ukraine's potential epidemic would likely undermine the economy, reducing the labor force and revenues and increasing government costs.

The cumulative number of people infected with HIV is estimated to reach 479,000-820,000 by 2014, with another 29,000-94,000 contracting it each year. The adult prevalence rate may reach 1.9-3.5 percent that same year, and those needing ART may increase to 130,000 (77,000 in the optimistic scenario). Annually, AIDS would cause an estimated 35,000-65,000 deaths, with similar numbers developing the disease each year. AIDS would account for almost a third of all male deaths and a staggering 60 percent of female deaths in the 15-49 age group by 2014, reducing life expectancy by 2-4 (3-5) years for males (females). The spread of HIV/AIDS would exacerbate Ukraine's already-adverse demographic situation: without AIDS, low fertility rates would drive the Ukrainian population down to 44.2 million by 2014; with it, an additional 300,000-500,000 would be lost, leaving a total population of 43.9-43.7 million.

Echoing the underlying demographic decline of 10.4 percent from 2004 to 2014, HIV/AIDS will cause an additional 1-2 percent reduction in labor force nationwide. The epidemic could contribute to labor force shrinkage in the worst-affected oblasts at rates of 2.7-3.6 percent for Donetsk and 2.2-4.2 percent for Odesa. The worst-affected oblasts in terms of HIV prevalence have the highest output per worker and the highest agricultural wages that drive inward migration. Younger people are most affected, with a pronounced gender differential (the sharpest decline is for females in the 15-19 age group). Longer-term negative demographic consequences follow from the reduced fertility among young, HIV-infected women.

As labor takes its hit, so do families and children. The medium scenario posits that 42,000 orphans will have lost both parents to AIDS by 2014, with another 105,000-169,000 having lost one parent, depending on the scenario. Those children are at risk of impeded access to quality education, health care, and even basic needs, unless they receive adequate assistance from the government. Implications include not only increased HIV/AIDS but even greater threats to society.

While its revenue shrinks with the workforce, the government would also experience increased medical expenditure and social security outlays. The study finds that depending on the cost scenario for ART and hospitalizations, annual AIDS care expenditure may be reach 630 million UAH by 2014 (estimate range: 41-629 million UAH, quite wide due to the high degree of uncertainty about exogenous factors such as future treatment costs).

Revenue losses through the fall in employment due to HIV/AIDS, forgone income taxes, and unpaid pension and social security (temporary disability and unemployment) levies are estimated to reach 263-418

million UAH (in optimistic-pessimistic scenarios). At the same time, projected additional budget expenditure in 2014 will require an extra 109-200 million UAH for permanent disability pensions due to HIV/AIDS, 20-35 million UAH in additional pensions from the social protection fund, 7-12 million UAH in temporary HIV disability payments, and 3-8 million UAH in AIDS orphan pensions. Thus, the total estimated HIV/AIDS-related additional benefits are 139-255 million UAH per year by 2014.

The study applied several macroeconomic models to estimate the magnitude of the macroeconomic effects likely to be caused by the HIV/AIDS epidemic in Ukraine based on the range of plausible scenarios. Implications from the models include the following mid-term effects (by 2014 with AIDS, compared to the "no-AIDS" baseline scenario):

- 1-6 percent reduction in the level of output (GDP in constant prices),
- 2-8 percent reduction in total welfare, and
- 1-9 percent reduction in investment.

The CGE analysis also demonstrates a decline in wages for unskilled, skilled, and highly skilled worker groups, driven by the HIV/AIDS-associated decline in labor productivity. On a sectoral level, the labor-intensive industries with the greater share of skilled and highly skilled workers proved to be especially vulnerable in terms of the production and export indicators.[14]

Sectoral analysis suggests that labor-intensive sectors whose labor inputs suffer from the epidemic will be among the worst affected. Based on the CGE, sectors such as production of non-energy materials as well as metallurgy and metal processing would be most affected, with output falling by up to a third in the worst-case scenario. Given the relative share of these sectors in the country's trade structure, the worst-case scenario anticipates a fall of 40 percent in exports of these sectors, which translates into 5.5 percent fall in GDP, an 8 percent fall in total welfare, and a 9 percent fall in investment. The macroeconometric model produces stronger effects for the agriculture sector, due to the higher estimated labor share in the production function.

In line with other international studies, the modeling results for Ukraine demonstrate that the HIV/AIDS epidemic could lead to potentially catastrophic consequences without an effective and timely national response. Even within the short to medium term, the study shows that the cost of inaction would be high and the long-term implication could be even higher.

The epidemic's distribution as reported here calls for attention to and effective targeting of the young, females, and those in the worst-affected oblasts. Prevention and treatment programs need to reach these groups and areas, and the messages and services must fit their needs. In addition, the pattern of transmission requires a prevention strategy focused on harm-reduction programs as well as sex education for young populations. Even though the mode of transmission is evolving toward heterosexuals, IDUs still constitute the majority of new infections. Special effort will have to be made to reach this marginalized group.

Given the important role they play in the Ukrainian economy, the worst-affected oblasts of Donetsk, Dnipropetrovsk, Odesa, and Mykolaiv should be treated with priority in implementing the HIV prevention, education, and treatment measures.

Due to the data limitation, this study could model only the impact of ART, one of many possible interventions. Nevertheless, the study demonstrates that prevention and treatment could be cost-effective,

[14] The most affected sectors in the CGE model are production of non-energy materials; mining of coal and peat; manufacture of chemicals and rubber; metallurgy and metal processing; and electric energy. The result of the macroeconometric model is the opposite, with agriculture posting the largest losses (1.2-2.3 percent of the baseline), followed by transport and communications (1.1-2.2 percent). Sectoral output in mining is estimated to decline by 0.1-0.2 percent. The model applied the largest losses to the labor force in the agricultural sector, which coincidentally is concentrated in the eastern oblasts with the highest HIV prevalence rates. See Annex 7 for details.

and scaling up the treatment could avoid the otherwise expected overburdening of the health system and escalating costs. Although not modeled here, preventive education measures must complement ART to enhance its impact.

Last, timing is crucial: as study results demonstrate, the epidemic is still spreading, so timely, effective interventions, including making ART available, could reverse the epidemic and reduce its negative impact on socioeconomic development in Ukraine.

ANNEX 1 HIV/AIDS in Ukraine: Official Data

Table A1-1. Reported New Cases of HIV Infection, AIDS Cases, and AIDS Deaths, Ukraine, 1987-2004

	Year										
	1987-95	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	Total
New HIV cases											
Total, including	1,897	5,422	8,934	8,590	5,830	6,216	7,009	8,761	10,013	12,494	75,166
Ukrainian nationals	1,673	5,400	8,913	8,575	5,827	6,212	7,000	8,756	10,009	12,491	74,856
Foreign nationals	224	22	21	15	3	4	9	5	4	3	310
Children	28	99	210	402	549	737	937	1,379	1,844	2,293	8,478
New AIDS cases											
Total, including	82	146	193	399	586	648	868	1,356	1,916	2,745	8,939
Ukrainian nationals	77	143	189	398	586	647	867	1,353	1,915	2,743	8,918
Foreign nationals	5	3	4	1	0	1	1	3	1	2	21
Children	7	10	4	14	15	13	30	47	68	96	304
AIDS deaths											
Total, including	38	70	85	150	253	415	474	837	1,285	1,775	5,382
Ukrainian nationals	34	69	82	148	253	414	473	834	1,285	1,775	5,367
Foreign nationals	4	1	3	2	0	1	1	3	0	0	15
Children	5	6	4	9	12	9	11	23	38	33	150

Source: Ukrainian AIDS Center.

Table A1-2. National HIV Serosurveillance Data by Category/Code, Ukraine, 2002-04

		2002			***2003***			***2004***		
CODE	CATEGORY	**Tested**	**HIV+**	**%**	**Tested**	**HIV+**	**%**	**Tested**	**HIV+**	**%**
100	*Total Ukrainian nationals, including*	2,299,981	15,572	0.68	2,459,784	18,522	0.75	2,501,132	23,087	0.92
101	*Sexual partner of an HIV+*	4,143	515	12.43	4,496	627	13.95	5,573	862	15.47
101`1	*Children born to HIV+ mothers*	12,940	1,163	8.99	14,727	1,216	8.26	16,182	1,729	10.68
102	*IDUs*	36,286	4,765	13.13	33,004	4,855	14.71	32,184	4,754	14.77

(continued on page 36)

Table A1-2. National HIV Serosurveillance Data by Category/Code, Ukraine, 2002-04 *(continued from page 35)*

CODE	CATEGORY	2002			2003			2004		
		Tested	**HIV+**	**%**	**Tested**	**HIV+**	**%**	**Tested**	**HIV+**	**%**
104	*Those with STIs*	67,921	584	0.86	61,674	685	1.11	59,960	720	1.20
105	*Multiple sexual partners*	16,050	160	1.00	17,196	187	1.09	16,715	243	1.45
108	*Donors of blood & products, organs, tissues*	939,108	927	0.10	958,205	1,182	0.12	941,524	1,209	0.13
109	*Pregnant women*	808,632	1,874	0.23	924,099	2,555	0.28	965,405	3,252	0.34
112	*Prisoners*	12,770	1,192	9.33	17,782	1,603	9.01	25,638	3,273	12.77
113	*Examined by clinical indications*	116,878	2,256	1.93	121,350	3,030	2.50	134,528	3,895	2.90
114	*Examined on voluntary basis (anonymously or confidentially)*	36,679	1,145	3.12	34,326	1,303	3.80	38,326	1,588	4.14
115	*Occupational exposure (medical contacts)*	4,677	26	0.56	4,938	7	0.14	5,648	2	0.04
120	*Other*	243,897	965	0.40	267,987	1,272	0.47	259,449	1,560	0.60
200	*Foreign nationals*	3,542	30	0.85	5,289	17	0.32	5,899	25	0.42
300	**Total tested**	**2,303,523**	**15,602**	**0.68**	**2,465,073**	**18,539**	**0.75**	**2,507,031**	**23,112**	**0.92**

Source: Ukrainian AIDS Center.

Table A1-3. Reported HIV Cases by Mode of Transmission, 1987-2004

Mode of transmission	Year										
	1987-95	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*Total*
IDU	1,024	4,360	7,448	6,516	3,771	3,881	3,964	4,587	4,815	5,778	46,144
Heterosexual	433	709	1,007	1,385	1,323	1,427	1,885	2,499	3,043	4,041	17,752
MTCT	19	92	196	378	527	727	914	1,371	1,830	2,273	8,327
Unknown	161	236	260	294	202	173	231	295	314	389	2,555
Blood transfusion	4	0	0	1	0	0	3	2	3	1	14
Medical contact	5	0	0	0	3	0	0	0	1	0	9
MSM	27	3	2	1	1	4	3	2	3	9	55
Total	**1,673**	**5,400**	**8,913**	**8,575**	**5,827**	**6,212**	**7,000**	**8,756**	**10,009**	**12,491**	**74,856**

Source: Ukrainian AIDS Center.

Table A1-4. Reported Cases of HIV Infection in Ukraine, by Gender, 1995-2004

Year	Total infected, including:	Males		Females	
		Persons	*%*	*Persons*	*%*
1995	1,490	936	62.8	554	37.2
1996	5,400	4,130	76.5	1,270	23.5
1997	8,913	6,569	73.7	2,344	26.3
1998	8,575	5,763	67.2	2,812	32.8
1999	5,827	3,757	64.5	2,070	35.5
2000	6,212	3,947	63.5	2,265	36.5
2001	7,000	4,326	61.8	2,674	38.2
2002	8,756	5,278	60.2	3,478	39.8
2003	10,009	5,695	56.9	4,314	43.1
2004	12,491	7,245	58	5,247	42
Total	**74,673**	**47,646**	**63.8**	**27,028**	**36.2**

Source: Ukrainian AIDS Center.

Table A1-5. Reported HIV and AIDS Incidence in Ukraine, by Region, 2001-04

Regions	Officially registered HIV incidence *Per 100,000*				Officially registered AIDS incidence *Per 100,000*			
	2001	*2002*	*2003*	*2004*	*2001*	*2002*	*2003*	*2004*
Crimea	24.1	31.7	33.4	37.2	3.8	9.2	13.4	16.8
Vinnitsa	6.2	4.7	9.8	11.1	0.6	1	2.3	2.8
Volyn	5.9	12.1	9.2	12.7	0.2	1.4	1.8	1.6
Dnipropetrovsk	26.2	41.8	49.7	59.8	0.7	4	6.4	8.8
Donetsk	31.2	32.1	38.7	52.9	4.3	6.3	8.9	15
Zhytomyr	8.7	8	9.4	11.8	1.3	1.1	0.8	1.9
Zakarpatska	1.7	1	1	1.3	0.2	0.1	0	1.9
Zaporizhya	9.8	8.1	13	16.9	1.8	2	2.5	4.4
Ivano-Frankivsk	1.4	1.6	3.3	4.8	0.3	0.1	0.6	0.6
Kyiv	12.6	17.4	18.8	21.6	1	1.8	2.1	4
Kirovograd	8	11	11.7	17.5	0.4	0.8	0.6	0.4
Lugansk	8	15.1	13.9	23	0.5	0.6	1.3	2.2
Lviv	4.4	5.4	6.6	8.5	0.4	1	1	1.5
Mykolayiv	32	42.7	48.1	57.5	2.6	4.4	3.1	11.3
Odesa	36.3	46.5	48.3	58.9	11.6	14.5	16.7	15.8
Poltava	8.3	6.8	9.1	8.8	0	0	0.9	2.4

(continued on page 38)

Table A1-5. Reported HIV and AIDS Incidence in Ukraine, by Region, 2001-2004 *(continued from page 37)*

Regions	Officially registered HIV incidence *Per 100,000*				Officially registered AIDS incidence *Per 100,000*			
	2001	*2002*	*2003*	*2004*	*2001*	*2002*	*2003*	*2004*
Rivne	2.2	7.4	8.2	9.1	0	0.1	1.5	0.6
Sumy	5.8	5.6	6.8	5.7	1.9	1.2	1.2	1.2
Ternopil	3.5	2.6	4.4	4.7	0.2	0.4	0.4	0.7
Kharkiv	5.4	7.5	13.6	14.2	0.2	0.4	1	0.7
Kherson	10.8	18.6	18.9	20	0.4	2.5	5.9	8.4
Khmelnytsky	8.9	21.2	16	14.2	0	0	3.3	3.1
Cherkasy	12.8	16	17	18.3	0.5	0.9	2.3	3.4
Chernivtsi	2.4	4	4.2	5.4	0.1	1	0.3	0.8
Chernigiv	10	9.6	12.9	20.1	0.2	0.5	0.2	0.4
Kyiv city	13.1	15.9	15.9	24	1.6	1.7	2.3	5.2
Sevastopol city	32.7	26	34.2	50.4	4.9	1.1	3.5	8.2
Total	**14.2**	**18.2**	**20.8**	**25.9**	**1.8**	**2.8**	**4**	**5.7**

Source: Ukrainian AIDS Center.

Table A1-6. Officially Reported HIV Incidence among Blood Donors and Pregnant Women, by Region, 2004

	% among donors	% among pregnant		% among donors	% among pregnant
AR Crimea	0.13	0.27	*Odesa*	0.25	0.60
Vinnitsa	0.06	0.09	*Poltava*	0.09	0.24
Volyn	0.05	0.11	*Rivne*	0.05	0.06
Dnipropetrovsk	0.24	0.7	*Sumy*	0.01	0.07
Donetsk	0.22	0.61	*Ternopil*	0.02	0.04
Zhytomyr	0.10	0.29	*Kharkiv*	0.09	0.13
Zakarpatska	0.01	0.10	*Kherson*	0.15	0.25
Zaporizhya	0.06	0.14	*Khmelnytsky*	0.08	0.42
Ivano-Frankivsk	0.06	0.05	*Cherkasy*	0.11	0.23
Kyiv	0.20	0.53	*Chernivtsi*	0.05	0.04
Kirovograd	0.17	0.48	*Chernigiv*	0.22	0.55
Lugansk	0.08	0.14	*Kyiv city*	0.14	0.54
Lviv	0.08	0.08	*Sevastopol city*	0.04	0.30
Mykolayiv	0.33	0.79	**Total**	**0.13**	**0.34**

Source: Ukrainian AIDS Center.

Table A1-7. HIV Seroprevalence Surveys among Injecting Drug Users (IDUs)

City	Year	Sample size	% HIV+
	1999	259	37.8
	2000	259	41.7
	2002	250	31.6
Poltava	2004	250	28.
	2000	252	39.7
	2002	250	40.0
Donetsk	2004	250	41.6
Kryvyi Rig	2000	249	28.1
	2000	293	64.0
	2002	259	58.3
Odesa	2004	250	58.1
	2000	261	27.2
	2002	250	28.
Simferopol	2004	363	59.0
	2000	250	17.8
	2002	250	16.
Kharkiv	2004	241	14.
Mykolaiv	2002	250	53
	2002	250	32.
Lutsk	2004	241	32.8
Sumy	2004	164	11.
Kherson	2004	250	31.2

Source: Artyukh et al. (2005a).

Table A1-8. HIV Seroprevalence Surveys among Commercial Sex Workers (CSWs)

City	Year	Sample size	% HIV+
	2000	53	13.2
	2002	102	31.4
Donetsk	2004	103	30.1
	2002	51	3.9
Lutsk	2004	51	9.8
	2002	103	22.3
Odesa	2004	124	31.1
	2002	100	17.0
Poltava	2004	100	18.0
	2002	100	6.0
Simferopol	2004	100	19.0
Mykolaiv	2002	100	30.0
Kharkiv	2002	90	12.2
Sumy	2004	20	10.0
Kherson	2004	100	11.0

Source: Artyukh et al. (2005b).

Table A1-9. HIV Seroprevalence Surveys among Patients with Sexually Transmitted Infections (STIs)

City	Year	Sample size	% HIV+
	1999	252	2.4
Kyiv	2000	500	1.8
	2000	476	1.3
	2002	482	1.2
Donetsk	2004	300	2.0
	2002	310	1.3
Lutsk	2004	300	1.3
	2002	333	9.6
Odesa	2004	327	9.0
	2002	300	1.7
Poltava	2004	300	3.7
	2002	300	12.3
Simferopol	2004	356	4.8
	2002	300	0.3
Kharkiv	2004	300	1.0
Sumy	2004	200	4.5
Kherson	2004	300	2.7

Source: Artyukh et al. (2005b).

ANNEX 2 Demographic Forecast: Methodology and Assumptions

We used the Futures Group[15] modeling tool Spectrum (DemProj and AIM modules) to estimate demographic, economic, and social costs of the HIV/AIDS epidemic, projecting it from its onset in 1994 to 2014. The medium-term forecast horizon allows us to remain confident about the key parameters and variables in the future: uncertainty about future values increases as we project out from the baseline year.

To forecast population and its age-gender composition, the medium demographic projection was used based on expert estimates by the Institute of Demography, National Academy of Sciences (NAS), of the future level of demographic indicators. The demographic scenario is based on assumptions about future fertility, mortality, and migration. It also assumes gradual improvement in Ukraine's socioeconomic situation, including sustained economic growth, increases in living standards, poverty reduction, and improvement in the quality and accessibility of medical services.

The forecast is based on the assumption of the gradual decrease in negative balance of migration, to a net outflow of 5,000 persons in 2009-10 and zero net outflow over 2011-14. Migration mobility of males and their contribution to the balance of external migration is projected to grow, causing the share of females among migrants to drop to 54 percent of the total in 2010. The age composition of migrants is calculated by extrapolating the smoothed annual data on age distribution of migrants for 1994-2003.

Demographic Assumptions

Baseline demographic inputs included Ukraine's 1994 population by age and gender, total fertility rate, mortality (based on Life Tables for Ukraine), and net migration. Demographic forecast is based on three major hypotheses:

Total fertility rate (TFR): Input TFR assumes that the decline observed in the 1990s has stabilized, with a gradual increase to follow (to 1.33 children per female in 2010 and 1.41 in 2014). The share of the youngest females in total births decreases, while the proportion of births attributed to the 30+ age groups rises.

Improved mortality indicators: Based on the analysis of the current socioeconomic situation and the prospects of its improvement, we assumed that in the near future further deterioration of population health subsides, mortality rates fall, and life expectancy at birth improves. This hypothesis assumes that by 2014, life expectancy in Ukraine reverts to its pre-crisis level of the early 1990s. Reduction in mortality rates and increased life expectancy will be more pronounced for males. By 2014, forecast life expectancy at birth is 65.6 years for males and 75.8 for females.

Migration: There is a significant degree of uncertainty in making assumptions about future migration patterns. Justification of any hypothesis with respect to migration flows requires consideration of many contradictory and sometimes ambiguous factors. In this analysis we accept the hypothesis of increased immigration and receding emigration. Among the factors contributing to such dynamics are:

- Improved economic conditions that weaken the "push" factor for out-migration,

[15] http://www.futuresgroup.com/Resources.cfm?area=2a&get=Spectrum.

Table A2-1. Spectrum AIM Inputs: Adult HIV Prevalence, 1994-2014

In percentages

1994-2003

Year	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*
Adult HIV prevalence	0.11	0.16	0.24	0.34	0.48	0.65	0.87	1.13	1.40	1.67

2004-14

Year	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Adult HIV prevalence											
Medium	1.84	2.07	2.24	2.37	2.44	2.48	2.48	2.46	2.43	2.38	2.33
Optimistic	1.72	1.76	1.81	1.86	1.91	1.95	2.00	1.98	1.95	1.92	1.90
Pessimistic	1.90	2.10	2.24	2.33	2.45	2.56	2.75	2.94	3.12	3.31	3.5

Source: Authors' calculations using the UNAIDS Workbook Method spreadsheet of concentrated epidemic.

- Repatriation policies with respect to ethnic Ukrainians in other Commonwealth of Independent States (CIS) countries and other ethnic groups (such as Crimean Tartars) previously deported from Ukraine, and
- A gradual weakening of "pull" factors for migration through ethnic links abroad.

Epidemiological Assumptions

Adult HIV Prevalence Rate

To calculate adult HIV prevalence, an essential input into the Spectrum AIM module, we used the UNAIDS Workbook Method spreadsheet. This tool (an Excel® spreadsheet) is used internationally to estimate and project adult HIV prevalence from surveillance data in countries with a low-level or concentrated epidemic.[16] Modeling options include (1) using sentinel surveillance data on HIV prevalence in risk groups or (2) using antenatal clinic (ANC) data on HIV prevalence among low-risk females (urban and rural). Our modelling used the former and estimated the size of model risk groups such as IDUs, their partners, MSM, their female partners, CSWs, their clients, and STI patients. We assumed the groups were growing in size at the same rate as total adult population (a negative growth rate of -1 percent per annum 2000-2010 and -0.9 percent per annum for 2010-14).

To estimate year/level of saturation in HIV prevalence in high-risk groups under low to high scenarios, we used the latest serosurveillance data and the results of the surveys among the risk groups (to estimate the year of peak prevalence). In the medium epidemic scenario we assume that the year of saturation/peak prevalence is 2007 for IDUs and 2010 for other risk groups. Low-high estimates of the risk groups sizes and group HIV prevalence allowed us to calculate three scenarios of adult HIV prevalence: medium, optimistic, and pessimistic. Three scenarios take identical values for 1994-2003 and diverge from 2004 (see Table A2-1):

In the model the epidemic starts in 1994 with an adult HIV prevalence rate of 0.11 percent. In the medium epidemic scenario this rate peaks at 2.48 percent in 2009-10 and gradually decreases thereafter to 2.33 percent in 2014. In the optimistic scenario, a peak prevalence rate of 2 percent is reached in 2010, with the gradual reduction to 1.9 percent in 2014. In the pessimistic scenario this rate increases over 2004-14 reaching 3.5 percent in 2014. These data were used as inputs to Spectrum AIM module.

[16] http://www.unaids.org/en/resources/epidemiology/epi_software-tools.asp.

Table A2-2. Concentrated Epidemic Workbook Inputs (MARPs Size and Peak Prevalence)

Population Group	Population size in base year		Annual growth rate				Prevalence base year		Saturation prev	Year of saturation
	Low	*High*	*2000-05*	*2005-10*	*2010-20*	*2020-30*	*Low*	*High*		
Adult Population 15-49	25,460,000		-1.0%	-1.0%	-0.9%	-0.9%				
Urban population percentage	70%									
1. Most-at-risk populations (MARPs)										
IDU	500,000	700,000	-1.0%	-1.0%	-0.9%	-0.9%	20.0%	45.0%	50.0%	2007
MSM	150,000	250,000	-1.0%	-1.0%	-0.9%	-0.9%	2.0%	6.0%	10.0%	2010
Sex workers	50,000	70,000	-1.0%	-1.0%	-0.9%	-0.9%	8.0%	18.0%	20.0%	2010
Clients of sex workers	200,000	300,000	-1.0%	-1.0%	-0.9%	-0.9%	3.00%	5.00%	7.0%	2010
2. Populations at lower risk (PLR) that are not already included in MARPs				Select one	x	Partners		ANC data		
a. Partners of high-risk populations	*Partners of MARPs chosen*									
Partners of IDUs	300,000	500,000	-1.0%	-1.0%	-0.9%	-0.9%	3.0%	5.0%	20.0%	2007
Female partners of MSM	75,000	125,000	-1.0%	-1.0%	-0.9%	-0.9%	1.5%	2.0%	5.0%	2010
Partners of clients of sex workers	*700,000*	1,000,000	-1.0%	-1.0%	-0.9%	-0.9%	0.70%	1.00%	5.0%	2010
Patients with STIs	600,000	1,100,000	-1.0%	-1.0%	-0.9%	-0.9%	1.00%	3.00%	5.0%	2010
b. ANC data applied to low-risk women										
Urban female low-risk population	8,862,000	8,876,000	-1.00%	-1.00%	-0.90%	-0.90%	0.90%	1.30%	2.20%	2010
Rural female low-risk population	3,798,000	3,804,000	-1.00%	-1.00%	-0.90%	-0.90%	0.80%	0.90%	1.50%	2010

Source: Authors' calculations.

Vertical transmission (MTCT). In 1994-98 the mother-to-child transmission (MTCT) rate was estimated at 32 percent, falling to 28 percent by 1999. Ukrainian AIDS Center data indicate that the MTCT rate dropped to 15.9 percent in 2003 due to the availability of pre- and perinatal ARV prophylaxis. We start with this MTCT rate and assume its further reduction: gradually to 5 percent in 2014 (medium); to 10 percent in 2004 and gradually to 5 percent in 2014 (optimistic); and gradual reduction to 10 percent in 2014 (pessimistic) scenarios.

Percentage of infants with AIDS dying in first year. We attempted to calculate this share based on the Ukrainian AIDS Center data but were concerned with the bias of our estimate, due to limited availability of data. As a result, a Spectrum default value of 67 percent was used.

Life expectancy after AIDS onset. International clinical experience suggests a 6-18-month life expectancy after AIDS onset. We used the default parameter (1 year) due to the lack of data for Ukraine.

Fertility of HIV-infected women (TFR reduction). Based on the Ukrainian AIDS Center estimate, the ratio of fertility of HIV-infected women to fertility of uninfected women is 0.7 for all age groups except teenagers; the TFR ratio for women aged 15-19 is 1.2.

HIV progression. The incubation period (the interval between infection and the start of AIDS symptoms) has been assigned the following Spectrum scenarios:

Scenarios	Adults	Children
Medium	Quick	Slow
Pessimistic	Quick	Slow
Optimistic	Slow	Slow

HIV age distribution. HIV age distribution was re-calculated separately for male and females based on the Ukrainian AIDS Center data.

Sex ratio (those infected with HIV). This ratio was calculated based on the actual data from the period 1994-2004. The ratio of female to male prevalence was 0.35 in 1994, 0.57 in 2000, and 0.76 in 2003. The trend was extrapolated to accommodate for the growing share of heterosexual transmission, reaching a ratio of 1 in 2014.

ARV availability. The medium scenario assumes that in 2004, 1 percent of those needing ARV therapy have access to it, rising to 5 percent in 2005, to 10 percent in 2008 and remaining at that level. The optimistic scenario assumes that in 2004, 1 percent of those in need have access, rising to 30 percent in 2010, and then to 50 percent in 2014. The pessimistic scenario assumes that in 2004, 1 percent of those in need have access, rising to 5 percent in 2005, and remaining at that level thereafter.

AIDS impacts. In addition to three epidemic scenarios, three plausible cost of treatment scenarios were considered, reflecting the degree of uncertainty with respect to cost of treatment and access to treatment by those who require it:

- ***Scenario A.*** ARV-low, hospitalization-low assumes availability of low-price ART (UAH 1,500 per annum in constant prices[17]) throughout the modeling horizon. It is also assumed that starting from 0 percent in 2004, 30 percent of AIDS cases are hospitalized by 2014, at an annual cost of UAH 1,500 per case;
- ***Scenario B.*** ARV-high, hospitalization-low assumes that the cost of an ARV treatment per year is UAH 7,500[18] in constant prices throughout the modeling horizon; 50 percent of AIDS cases are hospitalized by 2014, at an annual cost of UAH 7,500 per case;
- ***Scenario C.*** ARV-high, hospitalization-high assumes that the cost of an ARV treatment per year is UAH 7,500 in constant prices throughout the modelling horizon; 100 percent of AIDS cases are hospitalized by 2014, at an annual cost of UAH 7,500 per case.

[17] Data supplied by the World Health Organization (WHO) Kiev Office, based on the Clinton Foundation best negotiated price for generics. Exchange rate 1US$ = 5.3 UAH.

[18] Ministry of Health estimate, 2004.

Table A2-3. Estimated Cumulative Number of Those Infected (in Thousands) and Corresponding Adult HIV Prevalence Rate (Percentage), Ukraine, 2004-14

Year	AIDS Medium			AIDS Optimistic			AIDS Pessimistic		
	Infected with HIV		*Adult prevalence rate, %*	*Infected with HIV*		*Adult prevalence rate, %*	*Infected with HIV*		*Adult prevalence rate, %*
	TOTAL	**PREGNANT WOMEN**		**TOTAL**	**PREGNANT WOMEN**		**TOTAL**	**PREGNANT WOMEN**	
2004	476.69	8.95	1.83	447.78	8.26	1.72	491.16	9.28	1.89
2005	536.75	10.34	2.06	459.96	8.51	1.76	544.12	10.49	2.09
2006	582.53	11.47	2.23	474.42	8.88	1.81	582.51	11.45	2.23
2007	616.42	12.39	2.37	487.97	9.27	1.86	606.18	12.09	2.33
2008	634.17	12.98	2.44	500.85	9.71	1.92	634.97	12.99	2.44
2009	640.67	13.25	2.49	508.61	9.98	1.96	657.94	13.73	2.56
2010	634.36	13.27	2.49	517.31	10.41	2.02	695.83	14.99	2.74
2011	620.93	13.26	2.47	508.9	10.49	2.02	731.07	16.31	2.93
2012	603.26	13.03	2.44	497.03	10.42	2.00	760.86	17.36	3.11
2013	580.97	12.77	2.39	486.39	10.47	1.99	791.3	18.52	3.3
2014	558.3	12.45	2.34	478.5	10.54	1.98	820.42	19.51	3.49

Source: Authors' calculations.

Table A2-4. Forecasted New Cases of HIV Infection and AIDS, and Annual AIDS Deaths

In thousands

Year	AIDS Medium			AIDS Optimistic			AIDS Pessimistic		
	NEW CASES			NEW CASES			NEW CASES		
	HIV	*AIDS*	*AIDS deaths*	*HIV*	*AIDS*	*AIDS deaths*	*HIV*	*AIDS*	*AIDS deaths*
2004	63.32	23.84	18.38	27.24	13.7	9.78	77.69	23.76	18.3
2005	82.35	29.49	23.1	26.13	18.11	13.18	75.21	29.69	22.99
2006	72.92	35.71	28.8	31.6	22.59	17.19	65.46	35.91	29.46
2007	66.5	41.51	34.76	34.52	26.42	21.23	56.95	41.69	35.68
2008	56.16	46.89	40.68	37.67	30.4	24.67	68.11	46.97	41.49
2009	50.76	51.38	46.39	36.04	33.99	28.13	68.07	51.66	46.79
2010	43.37	55.08	50.96	40.2	36.63	31.26	88.08	55.71	51.52
2011	40.62	57.59	54.72	25.61	38.19	33.49	90.07	59.31	55.6
2012	39.88	58.9	57.32	23.9	38.74	34.82	88.58	62.4	59.21
2013	37.58	59.06	58.73	26.12	38.2	35.27	92.7	64.95	62.33
2014	38.32	58.16	58.99	29.33	36.77	34.81	94.35	67.26	64.91

Source: Authors' calculations.

Table A2-5. Forecasted Number of Those Infected with HIV, Dnipropetrovsk, Donetsk, Mykolayiv, and Odesa Oblasts, 2004-14

	Number infected with HIV, thousand						Percentage of total	
	2004		2010		2014		2014	
Oblast	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*
Dnipropetrovsk	–	32.6	–	77.6	–	85.3	–	10.4
Donetsk	51.3	52.5	92.7	103.5	92.2	105.6	19.3	12.9
Mykolayiv	15.6	15.0	30.7	36.7	32.5	44.2	6.8	5.4
Odesa	29.9	25.1	49.5	72.6	48.9	116.1	10.2	14.2
4 oblasts in total	96.8	125.2	172.9	290.4	173.6	351.2	36.3	42.9
Ukraine	447.8	491.2	517.3	695.8	478.5	820.4	100.0	100.0

Source: Authors' calculations.

Table A2-6. Forecasted Annual AIDS Deaths, Dnipropetrovsk, Donetsk, Mykolayiv and Odesa Oblasts, 2004-14

In thousands

	2004		2010		2014	
Oblasts	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*
Dnipropetrovsk	–	1.4	–	4.1	–	6.7
Donetsk	1.0	1.8	3.6	6.2	5.5	9.2
Mykolayiv	0.3	0.5	1.1	1.6	1.9	2.9
Odesa	0.5	0.9	2.0	2.7	3.3	5.6
4 oblasts in total	1.8	4.6	6.7	14.6	10.7	24.4
Ukraine	9.8	18.3	31.3	51.5	34.8	64.9

Source: Authors' calculations.

Table A2-7. Forecasted Accumulated AIDS Deaths, Dnipropetrovsk, Donetsk, Mykolayiv, and Odesa Oblasts, 2004-14

	Accumulated AIDS deaths, thousand						Percentage of total	
	2004		2010		2014		2014	
Oblasts	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*
Dnipropetrovsk	–	3.9	–	19.9	–	43.1	–	8.2
Donetsk	2.9	6.0	17.2	30.6	36.8	63.3	12.2	12.
Mykolayiv	0.8	1.7	5.0	8.0	11.2	17.5	3.7	3.3
Odesa	1.6	3.3	9.6	14.3	20.8	31.7	6.9	6.
4 oblasts in total	5.3	14.9	31.8	72.8	68.8	155.6	22.8	29.5
Ukraine	27.2	56.4	162.9	284.3	301.3	526.4	100.0	100.0

Source: Authors' calculations.

Table A2-8. Estimated Indicators of AIDS-Related Mortality in the Working-age (15-59) Population, Dnipropetrovsk, Donetsk, Mykolayiv, and Odesa Oblasts, 2014

	Annual AIDS deaths, 15-59 age group, '000		Percentage of AIDS deaths in total number of deaths,15-59 age group	
Oblasts	*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*
Dnipropetrovsk	–	6.5	–	38.8
Donetsk	5.3	8.9	22.8	33.2
Mykolayiv	1.8	2.8	26.9	36.1
Odesa	3.1	5.3	25.1	36.6
Ukraine	33.2	61.7	17.0	27.8

Source: Authors' calculations.

Table A2-9. Estimated Reduction in Life Expectancy due to AIDS, Dnipropetrovsk, Donetsk, Mykolayiv and Odesa Oblasts, 2014

In years

	Life expectancy without AIDS	Life expectancy with AIDS		AIDS-induced reduction in life expectancy	
Oblasts		*Optimistic*	*Pessimistic*	*Optimistic*	*Pessimistic*
Males					
Dnipropetrovsk	64.4	–	59.0	–	5.4
Donetsk	63.8	60.1	58.4	3.7	5.4
Mykolayiv	63.4	59.3	56.9	4.1	6.5
Odesa	64.1	60.7	57.0	3.4	7.1
Ukraine	65.6	63.4	61.6	2.2	4.0
Females					
Dnipropetrovsk	74.9	–	68.7	–	6.2
Donetsk	75.0	70.1	68.3	4.9	6.7
Mykolayiv	74.3	69.1	66.6	5.2	7.7
Odesa	73.9	69.6	66.1	4.3	7.8
Ukraine	75.8	72.9	71.0	2.9	4.8

Source: Authors' calculations.

Table A2-10. Forecasted Total Population in the Range of AIDS Scenarios, Dnipropetrovsk, Donetsk, Mykolayiv and Odesa Oblasts

In millions

Oblasts	2004	2014		
	No-AIDS	No-AIDS	AIDS optimistic	AIDS pessimistic
Dnipropetrovsk	3.49	3.27	–	3.23
Donetsk	4.69	4.25	4.21	4.19
Mykolayiv	1.23	1.17	1.16	1.15
Odesa	2.41	2.29	2.27	2.26

Source: Authors' calculations.

ANNEX 3 Methodology for Estimating Labor Force and Employment

Analysis at National Level

This section presents projectons of the following indicators: working-age population, total labor force, and employed and unemployed population, by five-year age group and gender, over the 2004-14 period.

Working-age Population

The study assumes any person aged 15-70 is a working-age person ("adult") who may be either in or out of the labor force. The five-year age group and gender projections of these adults are based on actual labor force participation data for 1998-2003 and the demographic forecast from Chapter 3. It is estimated that the working-age population declines by 2.4 million over the forecast period. The number of adult females falls faster than that of males. The share of males (females) in the total adult population is 47 percent (53 percent) and is constant within the forecast period. Note that the population in several five-year age groups increases (see Table A3-1).

Table A3-1. Estimated Increase in Population by Age Group, 2004-14

Age group	Percentage increase
25-29	6.9
30-34	4.8
35-39	5.7
50-54	2.7
55-59	39.6

Source: Demographic forecast (Chapter 3).

Labor Force (Economically Active Population)

Labor force, or the economically active population, is comprised of adults (15-70) of both sexes who supplied labor in a labor market during a reference period. This category includes those employed or actively looking for a job (unemployed by the ILO definition). Other categories, such as students, pensioners (disability and other categories), unpaid home-makers and domestic caregivers, discouraged job seekers, and others not actively seeking a job are classified as "not in labor force."

Labor force forecast is implemented using the demographic forecast of the working-age population and the estimated population trend for groups outside the labor force. The projected labor force declines by 2.3 million persons (11.5 percent) over 2004-14. Based on the State Statistics Committee data for 1998-2003, it has been declining, with the overall reduction of 3.3 million (1.2 million males and 2.1 million females). The gender structure of labor force has also changed, with the share of males in total labor force increasing from 49.2 percent in 1998 to 51.1 percent in 2003 (and a corresponding share of females declining from 50.8 percent to 48.9 percent). This tendency is preserved over the ten-year forecast horizon, with the share of males in total labor force reaching 52.3 percent by 2014. Figure A3-1 presents the labor force projection by gender.

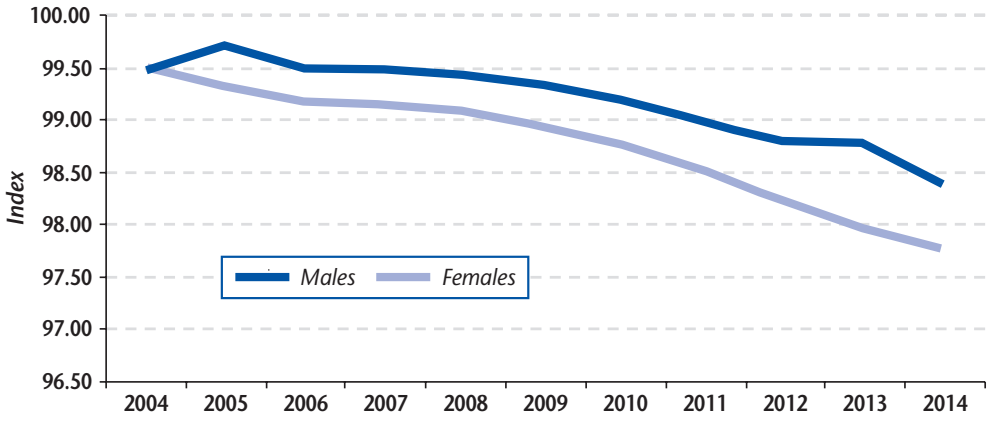
The economically active population is estimated to decrease in virtually all age groups, due to the underlying demographic forecast and decreased labor force participation rates in some age groups. However, we predict an increase in the economically active population aged 35-39.

Employed Population

By definition, people aged 15-70 are considered employed if during the reference period (the week of the survey) they supplied at least one hour to a labor

market in paid employment or for an in-kind reward; or they were self-employed or worked for their family business; or they worked at least 30 hours per week without pay for a family business or enterprise, including own farm, in order to sell the enterprise's product; or they were temporarily absent from their official workplace/own business due to circumstances beyond their control.

Figure A3-1. Labor Force Reductions by Gender, 2004-14



Source: Authors' calculations.

The analysis was conducted by five-year age group and gender, using actual employment data by age-gender group, projected GDP growth rates, and projected labor productivity. Employment in period t+1 is given by equation (1)

$$Ei_{t+1} = Ei_t * \frac{\Delta GDP_{t+1}}{\Delta PL_{t+1}}, \quad (1)$$

$$\text{if } \frac{Ei_t * \left(\Delta GDP_{t+1} / \Delta PL_{t+1}\right)}{EAi_{t+1}} \leq \frac{Ei_t}{EAi_t}, \text{ where} \quad (2)$$

Ei_{t+1}, Ei_t – employment in the age group i in year $t+1$ and t;

ΔGDP_{t+1} – change in GDP over $[t; t+1)$;

ΔPL_{t+1} – change in labor productivity (value added per employee);

EAi_t, EAi_{t+1} – number of economically active people from age group i during period t and $t+1$;

i – index of a five-year age group (from 15-70); t - base year; $t+1$ - forecast year.

If inequality (2) does not hold, next period of employment is calculated using last period share of employment (equation (3)):

$$Ei_{t+1} = EAi_{t+1} * \frac{Ei_t}{EAi_t} \quad (3)$$

According to our forecast, total employment will decline from 20.4 million in 2004 to 18.3 million in 2014: 10.4 percent. In particular, the number of employed males will decrease over the forecast horizon by 8.3 percent (from 10.4 million to 9.5 million) with a corresponding 12.6 percent drop for females (from 10.03 million to 8.8 million). Despite the general decline, absolute employment grows in some age groups. For instance, for males we observe an increase in the number of employed by 6 percent in the 20-24 age group during 2004-08; by 9.7 percent in the 55-59 age group over 2004-09; by 8.3 percent in the 25-29 age group; and by 2.4 percent in the 35-39 age group over 2004-14. For females, we estimate an increase in the number employed by 7.6 percent in the 20-24 age group over 2004-09; by 12.4 percent in the 35-39 age group over 2004-14; and by 40.5 percent in the 55-59 age group over 2004-11 (Table A3-2 on page 50).

Figure A3-2 on page 50 shows that there are also changes in the relative index of employment by gender; the share of employed in the total of economically active population marginally increases (from 0.9055 to 0.9057) for males and decreases (from 0.9124 to 0.9119) for females over 2004-14.

Unemployed Population

Based on the ILO definition, the unemployed are persons 15-70 years of age (either registered with the State Employment Service or not) who meet all of the following requirements:

a) Not in paid employment or self-employed;

Table A3-2. Estimated Increase in Absolute Employment, by Age Group and Gender

Males			Females		
Age group	*Period*	*Percentage increase*	*Age group*	*Period*	*Percentage increase*
20-24	2004-08	6.01	20-24	2004-09	7.59
25-29	2004-14	8.29			
35-39	2004-14	2.37	35-39	2004-14	12.36
55-59	2004-09	9.74	55-59	2004-11	40.47

Source: Authors' calculations.

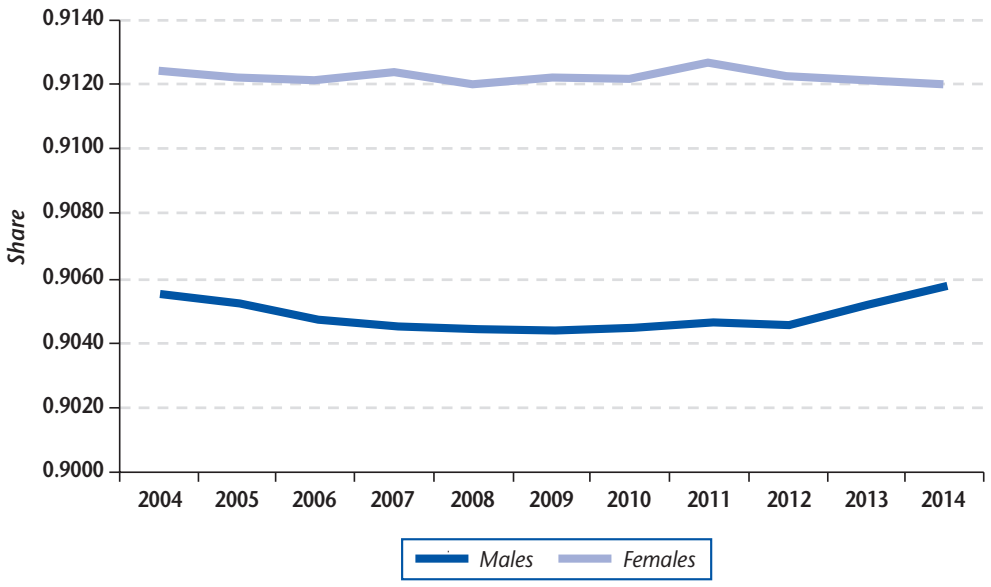
b) Actively looking for a job or trying to set up their own business within the past 4 weeks prior to survey;
c) Available to start at a new job within the following 2 weeks.

The unemployed category also includes those who have received an offer of paid employment and will start some time in the future, as well as those in training at the request of the State Employment Service. In line with the ILO methodology, the unemployed population is calculated as the difference between the economically active and employed populations. We estimate that the unemployed population decreases over the forecast horizon from 2.1 million in 2004 to 1.8 in 2014, or by 10.2 percent. In particular, the number of unemployed decreases over this period by 8.52 percent for males (from 1.1 million in 2004 to 994,000 in 2014) and by 12.1 percent for females (from 963,000 in 2004 to 847,000 in 2014). This corresponds to the reduction in unemployment rate from 9.5 percent to 9.4 percent for males over 2004-14, with only a marginal change for females whose unemployment rate is about 8.8 percent (Figure A3-3)

Labor Force in Three HIV/AIDS Epidemic Scenarios

Based on the demographic and epidemiological forecasts from Chapter 3 and using the methodology of the previous section, we constructed labor force projections in three epidemic scenarios: medium, optimistic, and pessimistic. The forecast demonstrates that the decline in working-age, economically active, employed, and unemployed populations is occurring faster in all three "with-AIDS" scenarios than those in the "no-AIDS" scenario of the previous section.

Figure A3-2. Share of Employed in Total Economically Active Population by Gender, 2004-14



Source: Authors' calculations.

Working-age population: Impact of HIV/AIDS. We estimate that during 2004-14 the total working-age population will decrease by 2.7-2.9 million persons, depending on scenario (see Figure A3-4).

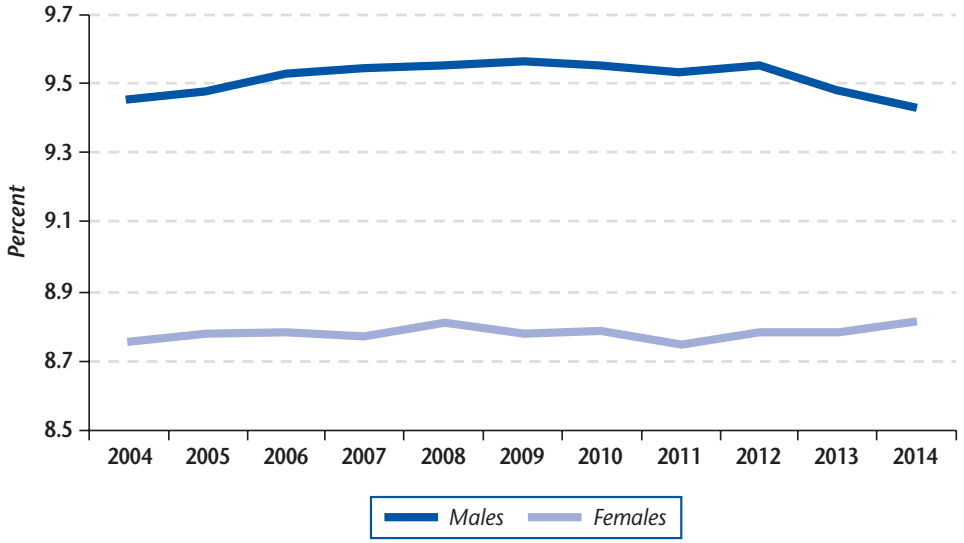
We calculate additional losses in the working-age population due to the impact of HIV/AIDS epidemic. By 2014, the reduction in this population attributed to HIV/AIDS constitutes 441,000 in the medium epidemic scenario (an additional 1.3 percent compared to the "no-AIDS" scenario), 268,000 (an

additional 0.8 percent) in optimistic and 472,000 (an additional 1.4 percent) in pessimistic scenarios, respectively (see Table A3-3 on page 52).

In some five-year age groups where an absolute increase was observed in the "no-AIDS" scenario, the magnitude of the increase diminished in all three epidemic scenarios with HIV/AIDS (Table A3-4 on page 52).

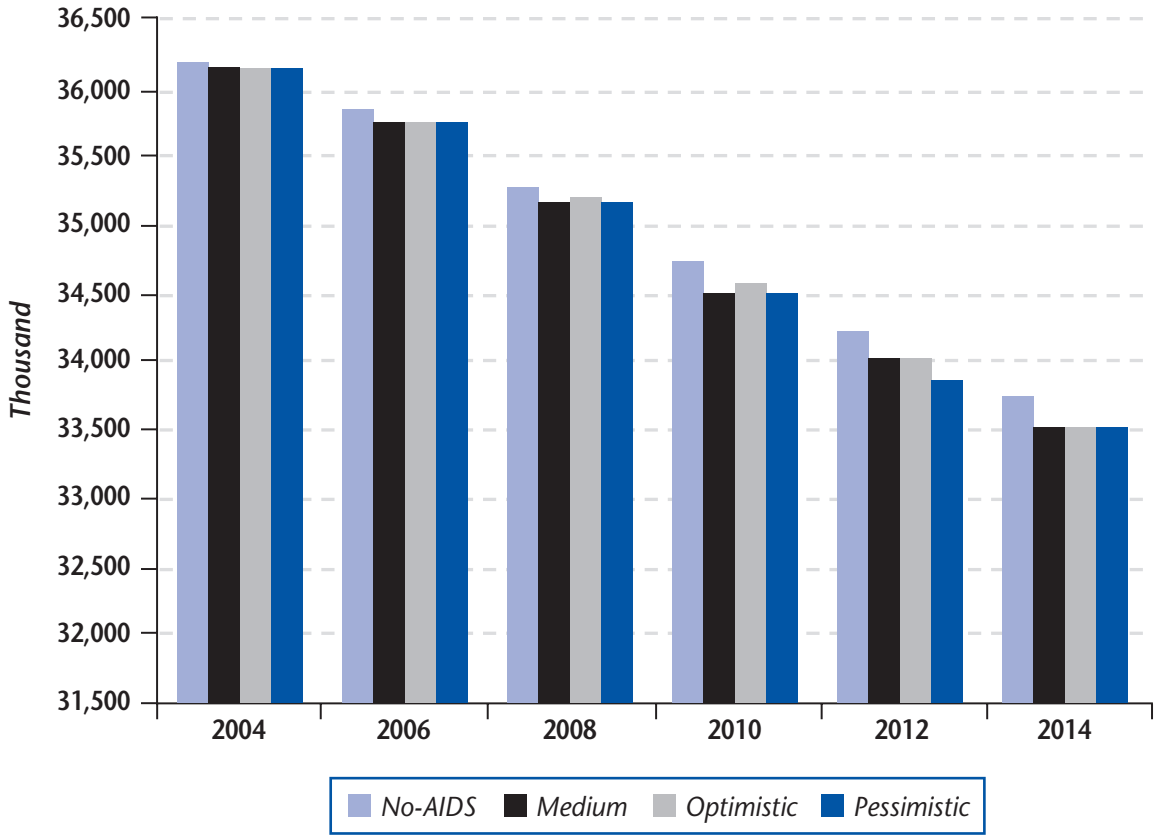
Labor force: Impact of HIV/AIDS. Total labor force decreases in all epidemic scenarios over the forecast horizon by 2.5-2.7 million (Figure A3-5 on page 52).

Figure A3-3. Unemployment Rates by Gender, 2004-14



Source: Authors' calculations.

Figure A3-4. Projected Working-Age Population in the Range of AIDS Scenarios, 2004-14



Source: Authors' calculations.

Table A3-3. Estimated Losses in the Working-Age Population due to the HIV/AIDS Epidemic, 2004-14

Scenario	Working age population, 2004 (million)	Working age population, 2014 (million)	Losses in working-age population		Additional losses due to HIV/AIDS	
			Total (million)	% of "no-AIDS" scenario	Total (thousand)	% of "no-AIDS" scenario
No-AIDS	36.17	33.75	2.42	—	—	—
AIDS Medium	36.15	33.29	2.86	18.21	441.1	1.31
AIDS Optimistic	36.13	33.44	2.69	11.07	268.1	0.79
AIDS Pessimistic	36.15	33.26	2.89	19.52	472 .8	1.40

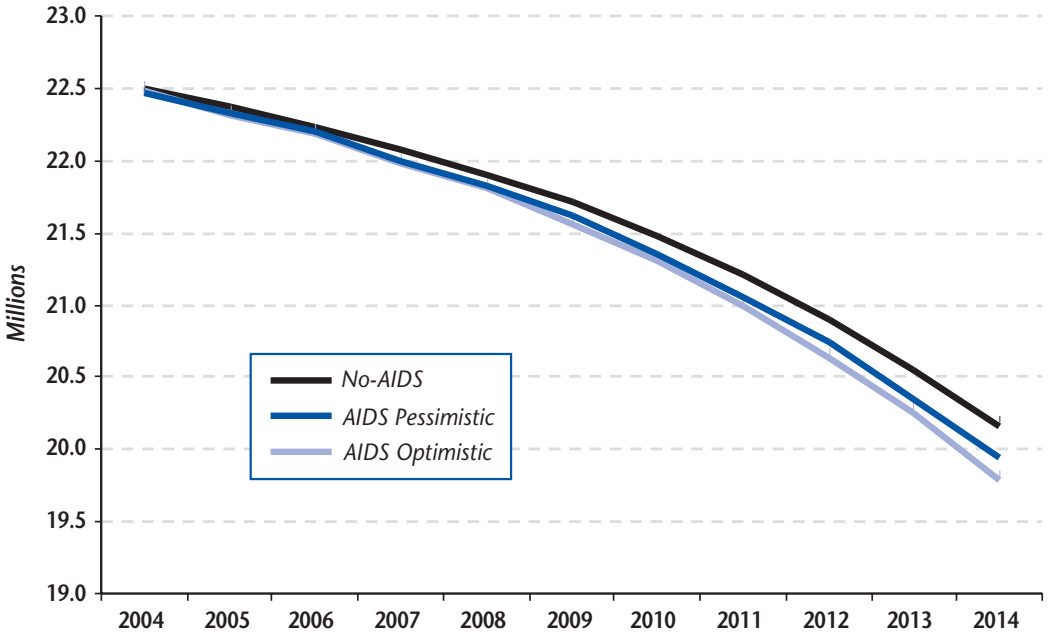
Source: Authors' calculations.

Table A3-4. Estimated Impact of HIV/AIDS on Selected Working-Age Groups, 2004-14

Age Group	% Increase in "no-AIDS" scenario	AIDS Optimistic		AIDS Pessimistic	
		% Increase	Difference	% Increase	Difference
25-29	6.9	6.6	0.3	5.8	1.1
30-34	4.8	3.3	1.5	1.5	3.3
35-39	5.7	3.5	2.2	2.2	3.5
50-54	2.7	2.1	0.6	1.8	0.9
55-59	39.6	39.4	0.3	38.9	0.7

Source: Authors' calculations.

Figure A3-5. Estimated Impact of HIV/AIDS on Labor Force, 2004-14



Source: Authors' calculations.

By 2014, additional losses in the labor force due to the HIV/AIDS epidemic are estimated to be 323,000 (an additional 1.6 percent compared to the "no-AIDS" demographic scenario) in the medium epidemic scenario, 193,000 (an additional 1 percent) in the optimistic one, and 351,000 (an additional 1.7 percent) in the pessimistic scenario (Table A3-5).

Note that the HIV/AIDS epidemic causes reductions in the number of economically active in all age groups, weakening the observed increase in the absolute number of economically active among certain age groups reported in the earlier section (see Table A3-6).

Table A3-5. Estimated Losses in Labor Force due to the HIV/AIDS Epidemic, 2004-14

In thousands

Scenario	Losses due to HIV/AIDS	
	Total	*Percentage additional to "no-AIDS" scenario*
AIDS Medium	323.4	1.6
AIDS Optimistic	193.2	0.96
AIDS Pessimistic	351.0	1.74

Source: Authors' calculations.

Employed Population: Impact of HIV/AIDS

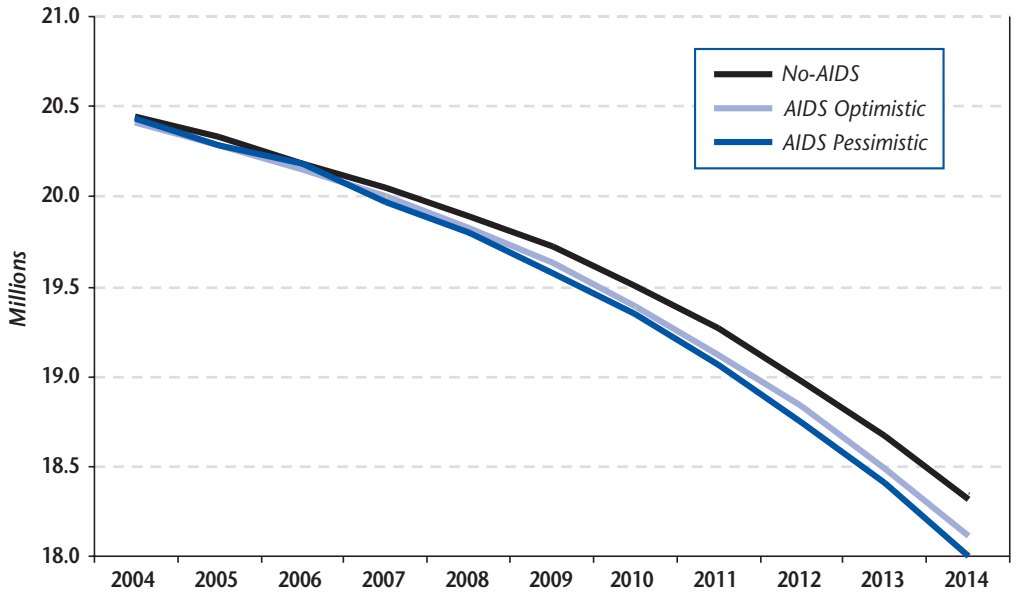
The total employed population is projected to decline over the forecast horizon in all epidemic scenarios by 2.3-2.4 million (Figure A3-6). Results by gender are presented in Table A3-7 on page 54. By 2014, additional losses in employed population due to the HIV/AIDS epidemic are estimated to be 171,000 (an additional 1 percent compared to the "no-AIDS" demographic scenario) in the optimistic epidemic scenario, and 302,000 (an additional 1.7 percent) in the pessimistic one (Tables A3-7 and A3-8 on page 54).

Table A3-6. Estimated Impact of HIV/AIDS on the Economically Active Population n Certain Age Groups, 2004-14

Age groups with with an increased economic activity	Percentage Increase, "no-AIDS"		Percentage Increase, AIDS Optimistic		Percentage Increase, AIDS Pessimistic	
	Males	*Females*	*Males*	*Females*	*Males*	*Females*
25-29	8.1	—	8.0	—	7.5	—
35-39	2.4	12.4	—	10.4	—	9.7

Source: Authors' calculations.

Figure A3-6. Estimated Impact of HIV/AIDS on the Employed Population, 2004-14



Source: Authors' calculations.

Analysis at Regional Level

To assess the impact of the HIV/AIDS epidemic on the regional level, we selected four oblasts: Donetsk, Dnipropterovsk, Odesa and Mykolayiv. The calculations

Table A3-7. Percentage of Estimated Losses in the Employed Population due to the HIV/AIDS Epidemic by Gender, 2004-2014

	Percentage decrease in employment			
	No-AIDS	*AIDS medium*	*AIDS optimistic*	*AIDS pessimistic*
Total employed	10.40	11.81	11.25	11.88
Males	8.28	10.05	9.23	10.65
Females	12.61	13.64	13.35	13.69

Source: Authors' calculations.

Table A3-8. Total Estimated Losses in the Employed Population due to the HIV/AIDS Epidemic, 2004-14

In thousands

Scenario	Losses in employed population due to HIV/AIDS	
	Total	*Percentage additional to "no-AIDS" scenario*
AIDS medium	286.4	1.6
AIDS optimistic	170.4	1.0
AIDS pessimistic	301.7	1.7

Source: Authors' calculations.

Table A3-9. Additional Losses in Working-age Population due to the HIV/AIDS Epidemic, Donetsk Oblast, 2004-14

In thousands

	Working-age population, 2004	*Working-age population, 2014*	Losses in working-age population	
			Total	*% of "no-AIDS" scenario*
No-AIDS	3,686.7	3,286.1	400.5	—
AIDS optimistic	3,686.7	3,244.7	441.9	10.3
AIDS pessimistic	3,686.7	3,214.1	472.5	18.0

Source: Authors' calculations.

were based on four demographic forecasts: the "no-AIDS" scenario and three epidemic scenarios with HIV (medium, optimistic, and pessimistic). We estimate the working-age, economically active, and employed and unemployed populations by gender using the same methodological approaches as in the national level analysis. Results confirm the expected reduction in the size of the working-age population and the labor force, including a reduction in the employed populations in all four oblasts.

Donetsk Oblast

The labor force forecast was conducted using three scenarios: "no-AIDS" demographic scenario and two "with-AIDS" scenarios, optimistic and pessimistic. The total working-age population of Donetsk Oblast is projected to decrease within the forecast period (2004-2014) by 4,005,000 in the "no-AIDS" scenario and by 4,419,000 (4,725,000) in optimistic (pessimistic) epidemic HIV/AIDS scenario, representing an additional loss of 414,000-720,000 persons of working age by 2014 due to the epidemic. Table A3-9 compares projected working-age population under optimistic and pessimistic scenarios to the "no-AIDS" demographic scenario.

The projected labor force will decline in all scenarios: by 232,000 (10.1 percent in the "no-AIDS") and by 2,925,000 (3,131,000) or 12.8 percent (13.7 percent) in optimistic (pessimistic) epidemic scenarios, respectively. Thus, by 2014 the HIV/AIDS epidemic causes and additional 2.7 percent (3.6 percent) decline in Donetsk's labor force in the optimistic (pessimistic) epidemiological scenario. Estimated labor force by gender in the pessimistic scenario is plotted in Figure A3-7. Figure A3-8 presents changes in the total labor force over 2004-14.

Direct losses in labor force due to the impact of the HIV/AIDS epidemic constitute 605,000 in the opti-

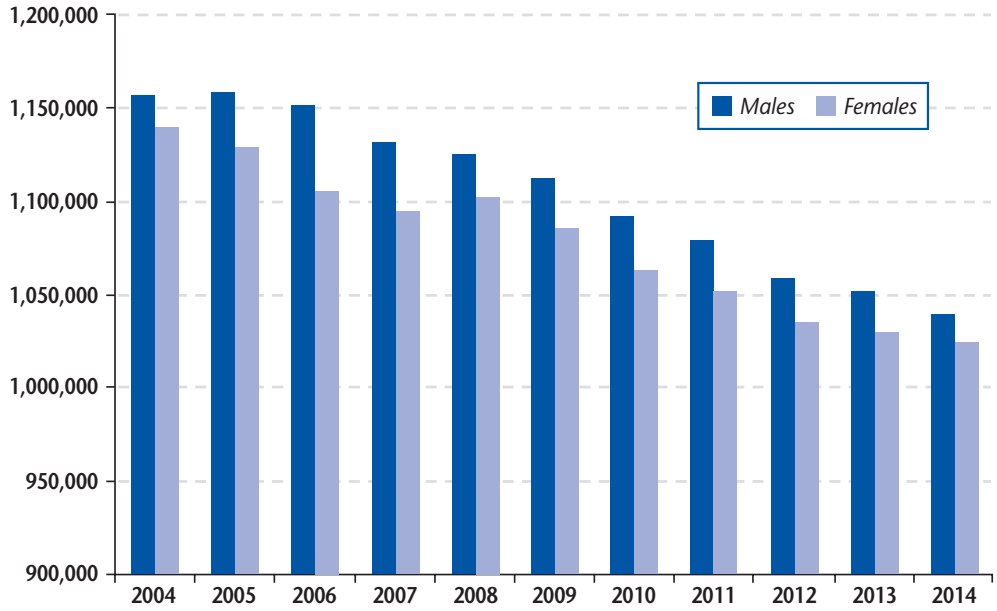
mistic and 811,000 persons in the pessimistic scenario.

Projected employed population in Donetsk Oblast also declines (Figure A3-9 on page 56), with larger losses observed for males than females.

In the "no-AIDS" demographic scenario, by 2014 the number of employed males (females) in Donetsk Oblast declines by 1,087,000 (1,049,000) persons, or 10.2 percent (10.0 percent) compared to 2004. The corresponding decline in the AIDS optimistic scenario is 1,467,000 (1,227,000) for males (females), representing an additional 3.5 percent (1.8 percent) decline compared to the demographic trend. In the pessimistic scenario, the projected decline in employed population is 1,478,000 (1,404,000) for males (females), or an additional 3.7 percent (3.5 percent) decline compared to the demographic trend. Thus, additional losses in Donetsk's employed population due to the epidemic are estimated at 558,000 in the optimistic and 747,000 in the pessimistic epidemic scenarios (Table A3-10 on page 57).

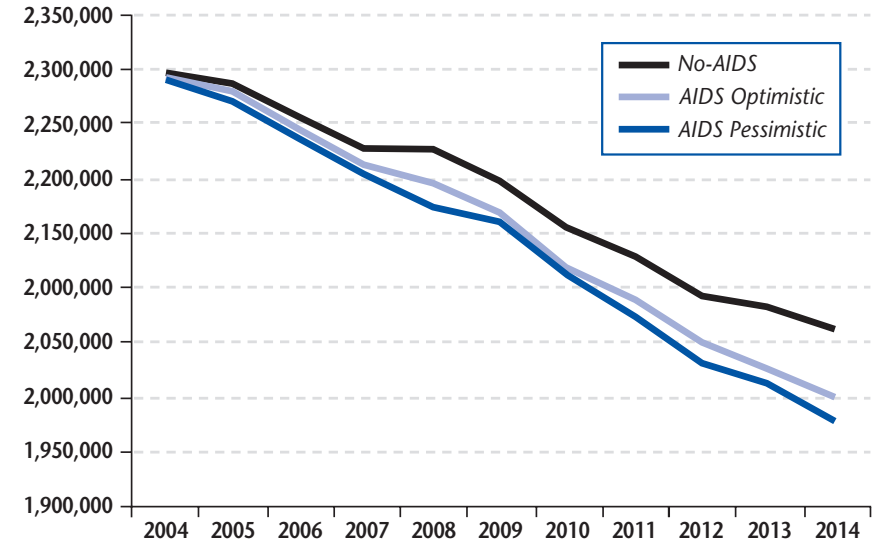
Within the entire forecast period and under all scenarios, there is the trend toward a decline in the total unemployed population as a result of reduction in the population as a whole. The forecast of unemployed persons is presented in Figure A3-10 on page 56. It demonstrates that in both epidemic scenarios, the number of unemployed decreases over the forecast horizon.

Figure A3-7. Estimated Labor Force by Gender in Pessimistic Scenario, Donetsk Oblast, 2004-14



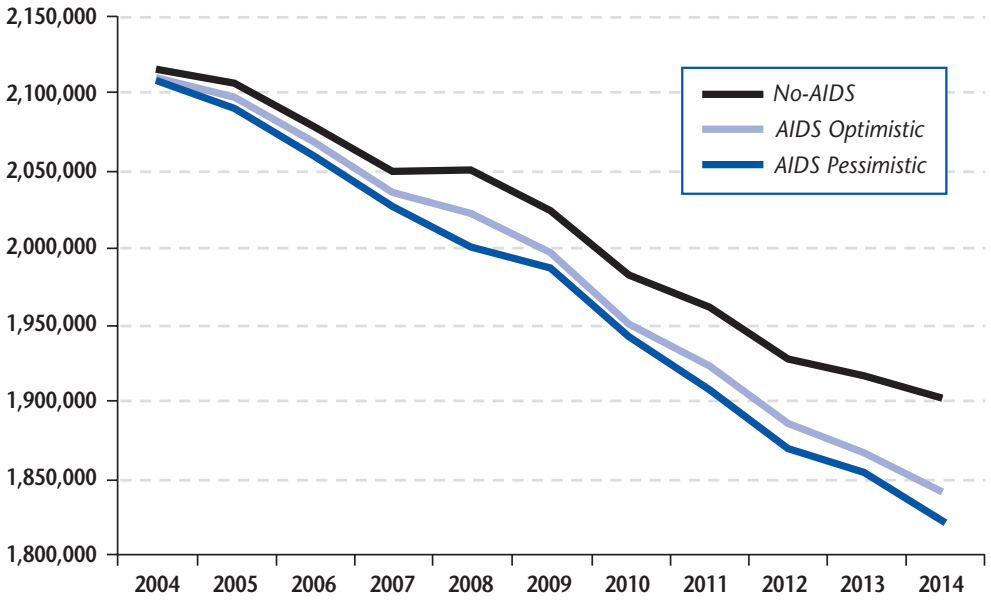
Source: Authors' calculations.

Figure A3-8. Estimated Total Labor Force in Three Scenarios ("No-AIDS," AIDS Optimistic and AIDS Pessimistic), Donetsk Oblast, 2004-14



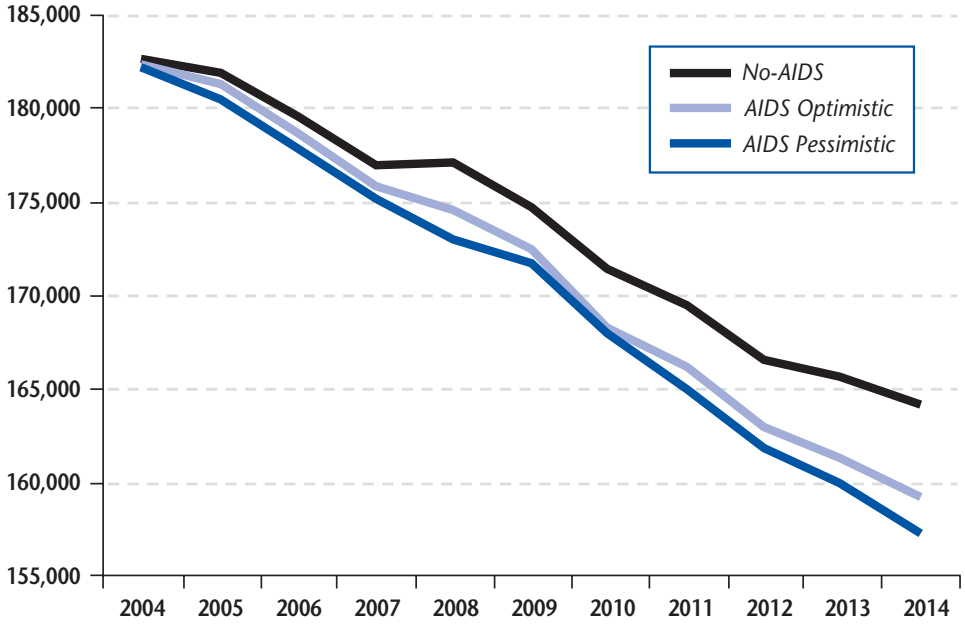
Source: Authors' calculations.

Figure A3-9. Projected Employed Population, Donetsk Oblast, 2004-14



Source: Authors' calculations.

Figure A3-10. Projected Unemployed Population, Donetsk Oblast, 2004-14



Source: Authors' calculations.

Table A3-10. Estimated Losses in Employed Population due to the HIV/AIDS Epidemic, Donetsk Oblast, 2004-14

In thousands

Scenarios	Employed Population, 2004	Employed Population, 2014	Losses in employed population		Losses in employed population due to HIV/AIDS	
			Total	Additional as % of "no-AIDS" increase	Total	Additional as % of "no-AIDS" increase
No-AIDS	2,112.6	1,899.0	213.6	—	—	—
AIDS optimistic	2,109.1	1,839.7	269.4	12.67	55.8	26.1
AIDS pessimistic	2,108.8	1,820.6	288.2	13.77	74.7	35.0

Source: Authors' calculations.

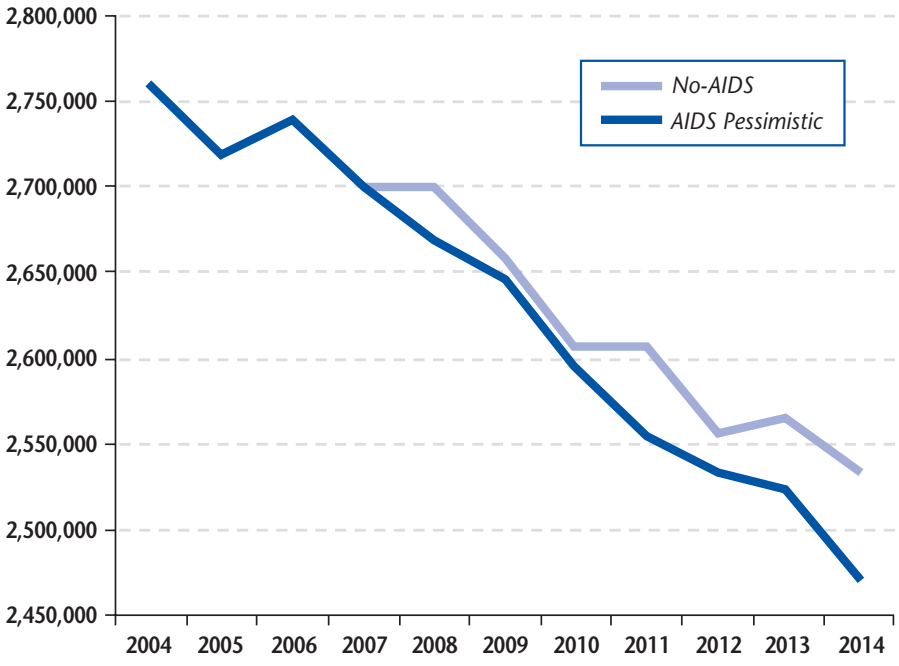
Dnipropetrovsk Oblast

Using the same methodology as above, a hypothetical "no-AIDS" demographic forecast was constructed for Dnipropetrovsk Oblast, supplemented with an epidemic forecast of HIV/AIDS in a pessimistic scenario only, due to data limitations. The total working-age population of the oblast is projected to decrease within the forecast period (2004-2014) by 2,274,000 (8.2 percent) in the "no-AIDS" scenario and by 2,894,000 (10.5 percent) in the pessimistic epidemic scenario. This constitutes an additional loss of 62,000 persons (2.3 percent) of working age due to HIV/AIDS over 2004-14 (Figure A3-11).

Projected labor force declines in both scenarios, by 146,000 (8.2 percent) in "no-AIDS" and by 214,000 (12.1 percent) in pessimistic epidemic scenarios. Estimated labor force by gender in the pessimistic scenario is plotted in Figure A3-12 on page 58. Note that the number of economically active males declines faster than that of females (a reduction of 11.1 percent over 2004-14 compared to 9.9 percent). Figure A3-13 on page 58 depicts the total projected labor force. Additional losses in labor force due to the HIV/AIDS epidemic are estimated at 68,000 persons, or an additional 3.9 percent to the baseline demographic losses.

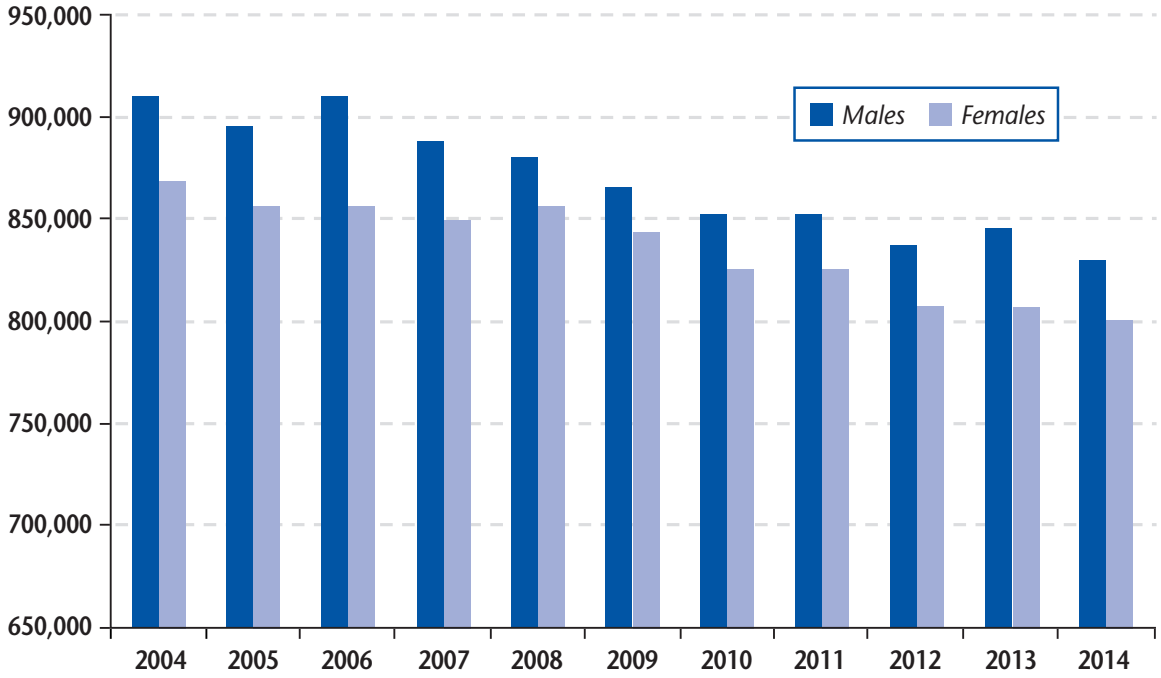
Projected employed population in Dnipropetrovsk Oblast declines over 2004-14 (see Figure A4-14 on page 59), by 134,000 (8.2 percent) in the "no-AIDS," and by 198,000 (12.1 percent) in pessimistic epidem-

Figure A3-11. Estimated Working-Age Population, Dnipropetrovsk Oblast, 2004-14



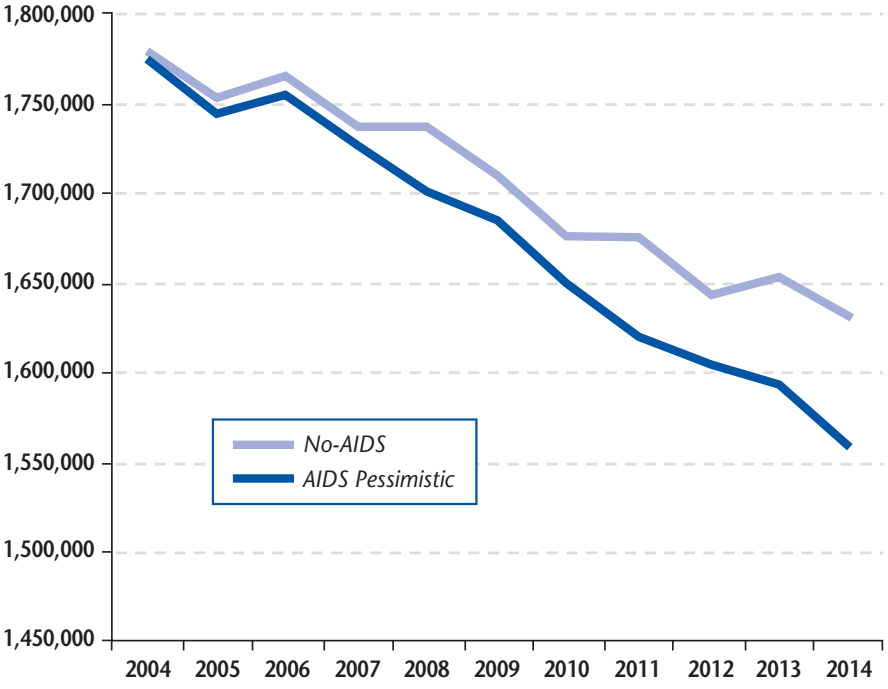
Source: Authors' calculations.

Figure A3-12. Estimated Labor Force by Gender in Pessimistic Scenario, Dnipropetrovsk Oblast, 2004-14



Source: Authors' calculations.

Figure A3-13. Estimated Total Labor Force, Dnipropetrovsk Oblast, 2004-14



Source: Authors' calculations.

ic scenarios. The decline in employed population is more pronounced for males than females. Additional losses in the employed population due to the HIV/AIDS epidemic amount to 66,000 by 2014, an additional 3.9 percent decline compared to the demographic trend.

Within the forecast period in both scenarios, the unemployed population in Dnipropetrovsk Oblast declines (see Figure A3-15).

Odesa Oblast

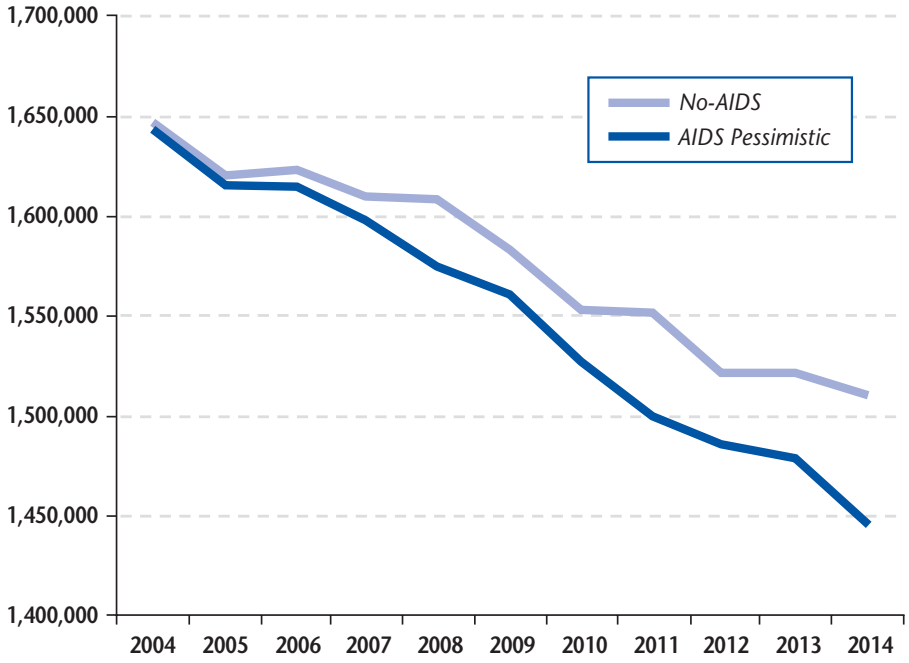
In the "no-AIDS" demographic scenario, the working-age population of Odesa Oblast is projected to decrease by 2014 by 7.6 percent from its 2004 level of 1.9 million. This represents a loss of 1,425,000, including 61,100 males (a 6.9 percent reduction) and 81,400 females

(a reduction of 8.3 percent). When the impact of HIV/AIDS is added, the working-age population is projected to decline over the period by 162,900 (8.7 percent) in the optimistic and 173,100 (10.2 percent) in the pessimistic epidemic scenarios. The labor force in Odesa Oblast is also projected to decrease over the forecast horizon: by 85,100 (7.5 percent) in the "no-AIDS" and by 110,200 (132,900) or 9.7 percent (11.7 percent) in the optimistic (pessimistic) scenarios. Table A3-11 on page 60 compares projected labor force under the HIV/AIDS scenarios to the "no-AIDS" scenario, allowing us to estimate additional losses in labor force due to the epidemic.

The employed population in Odesa Oblast under the "no-AIDS" scenario will drop from 1,077,000 in 2004 to 995,000 in 2014, that is, by 81,500 (7.6 percent). The number of males will decline over this period by 34,900 (7.0 percent), the number of females by 42,100 (8.2 percent). Figure A3-16 on page 60 presents the projected employed population under the "no-AIDS" and two epidemic scenarios, by gender.

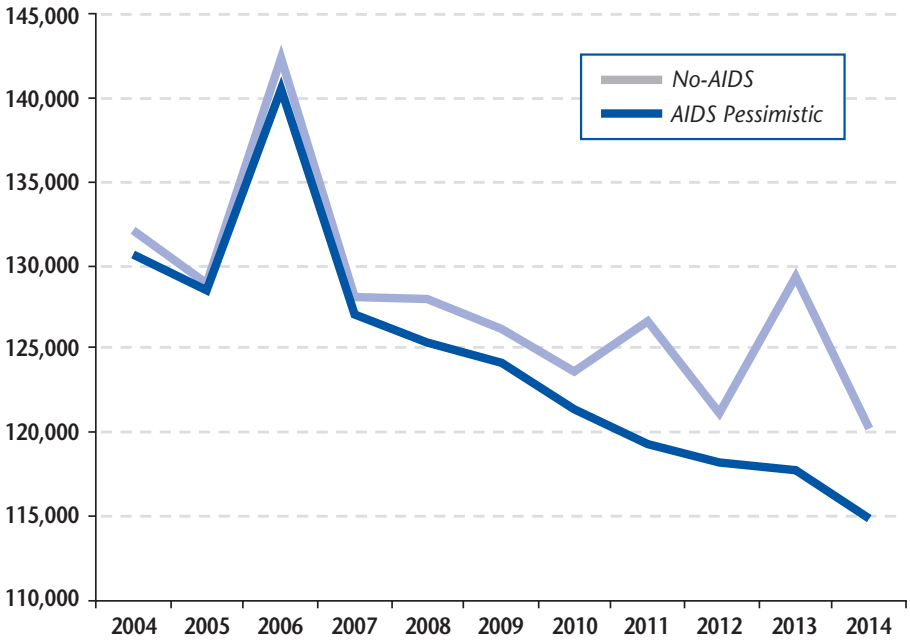
In the "AIDS optimistic" scenario, the decline in the employed population over the forecast horizon constitutes 93,000 persons (8.7 percent), or an additional loss of 11,500 persons (1.2 percent) due to the epidemic. Similarly, employment losses under the pessimistic epidemic scenario are 116,100 (10.9 percent), an additional reduction of 23,100 (3.3 percent) compared to the "no-AIDS" trend over 2004-14. The unemployed population will decrease by 2,700 (4.7 percent) in the "no-AIDS" scenario. The epidemic

Figure A3-14. Estimated Total Employment, Dnipropetrovsk Oblast, 2004-14



Source: Authors' calculations.

Figure A3-15. Projected Unemployed Population, Dnipropetrovsk Oblast, 2004-14



Source: Authors' calculations.

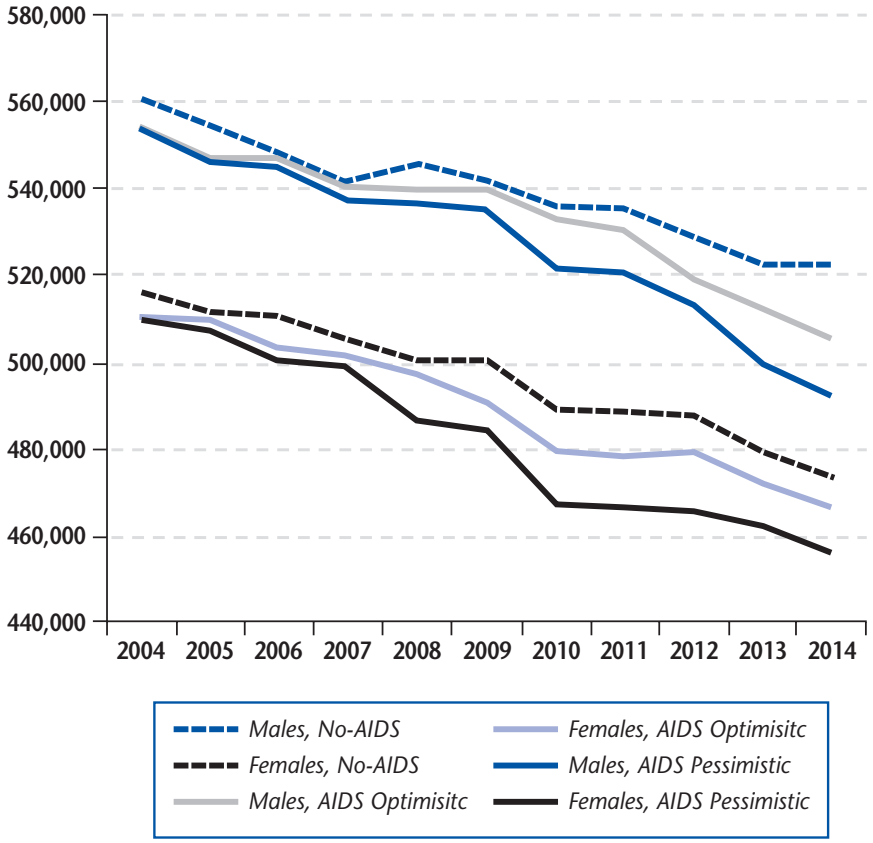
Table A3-11. Losses in Labor Force due to the HIV/AIDS Epidemic, Odesa Oblast, 2004-14

In thousands

Scenario	Losses in labor force		Additional losses due to HIV/AIDS		
	Total	*%*	*Total*	*Additional % of "no-AIDS" decrease*	*% of 2004 no-AIDS*
No-AIDS					
Total	85.0	7.5	—	—	—
Males	40.9	6.9	—	—	—
Females	44.1	8.2	—	—	—
AIDS optimistic					
Total	110.2	9.7	25.2	2.2	29.6
Males	59.1	9.9	18.2	3.0	44.5
Females	51.1	9.5	7.0	1.3	15.9
AIDS pessimistic					
Total	133.0	11.7	48.0	4.2	56.5
Males	72.1	12.1	31.2	5.2	76.3
Females	60.9	11.3	16.8	3.1	38.1

Source: Authors' calculations.

Figure A3-16. Projected Employed Population by Gender, Odesa Oblast, 2004-14



Source: Authors' calculations.

results in an additional reduction in unemployed population of 2,500-3,800 persons, or an additional 4.3-6.6 percent, depending on the epidemic scenario (Figure A3-17).

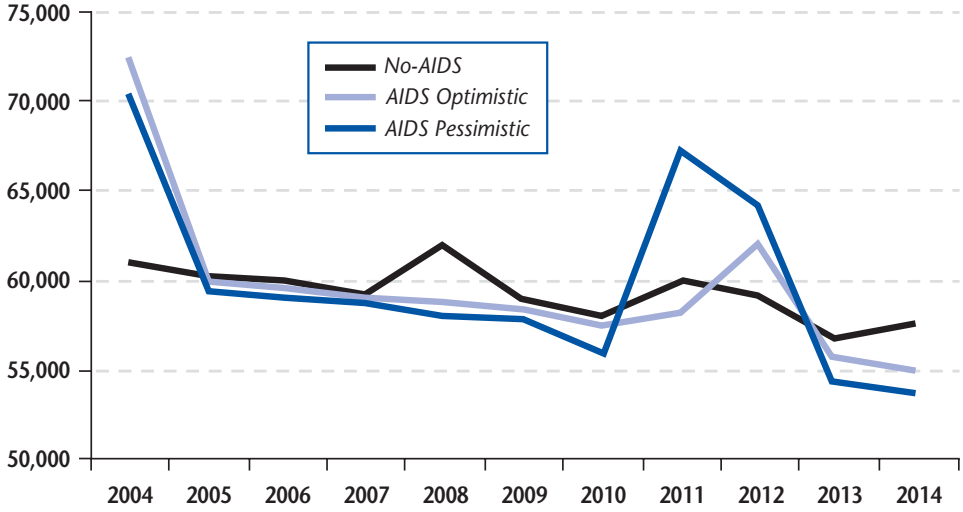
Mykolaiv Oblast

Within the forecast period the working-age population in Mykolayiv Oblast decreases by 7.5 percent in the "no-AIDS" scenario, and by 8.6 percent in the optimistic scenario with HIV/AIDS. By 2014, the labor force declines by 46,100 (7.8 percent) from its 2004 level of 591,400 in the "no-AIDS" optimistic scenario. Figure A3-18 illustrates the reduction in labor force under the "no-AIDS" and two epidemic scenarios.

The HIV/AIDS epidemic induces a reduction in labor force participation rate for Mykolayiv Oblast by 2 percentage points over 2004-14, from 61.9 percent to 59.7 percent. Additional losses in the labor force due to the epidemic by 2014 are 11,500-24,400 persons (see Table A3-12 on page 62).

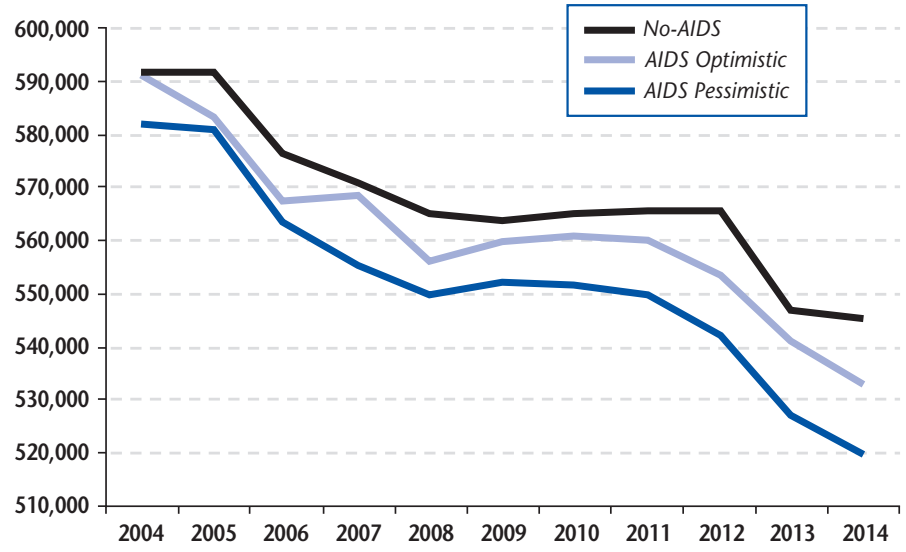
The projected decrease in the employed population in Mykolayiv Oblast within the ten-year horizon is 39,200 or 7.7 percent in the "no-AIDS" scenario, 8.7 percent in the optimistic, and 10.8 percent in the pessimistic epidemic scenarios (Figure A3-19 on page 62). Additional losses due to the HIV/AIDS epidemic are 5,000-15,000 persons.

Figure A3-17. Projected Unemployed Population, Odesa Oblast, 2004-14



Source: Authors' calculations.

Figure A3-18. Projected Labor Force, Mykolaiv Oblast, 2004-14



Source: Authors' calculations.

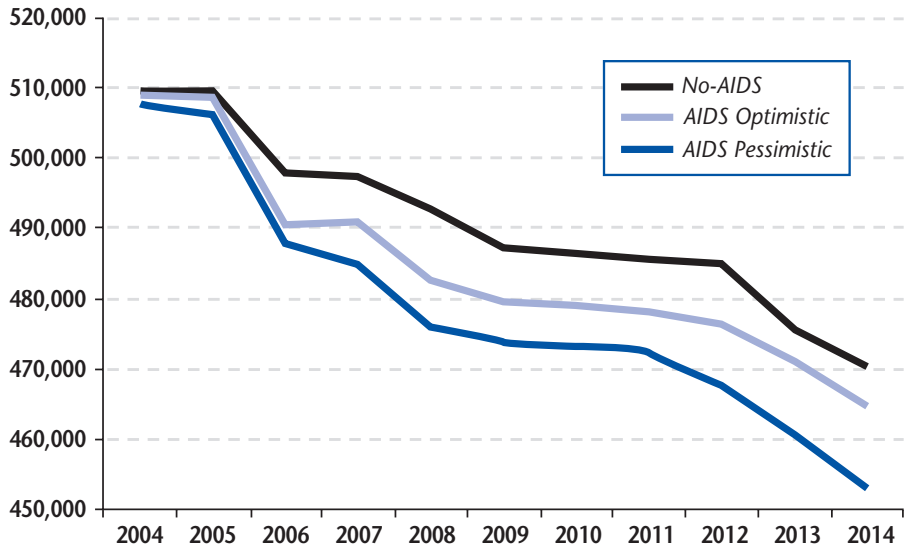
Table A3-12. Projected Labor Force in Three Scenarios, Mykolayiv Oblast, 2004-14

In thousands

			Losses in labor force		Additional losses in labor force due to HIV/AIDS	
	Labor force 2004	*Labor force 2014*	*Total*	*% "no-AIDS" 2004*	*Total*	*% of losses under "no-AIDS" scenario*
No-AIDS	591.4	545.3	46.1	—	—	—
AIDS optimistic	590.7	533.1	57.6	9.7	11.5	24.9
AIDS pessimistic	590.0	519.5	70.5	11.9	24.4	52.9

Source: Authors' calculations.

Figure A3-19. Projected Employed Population, Mykolayiv Oblast, 2004-14



Source: Authors' calculations.

ANNEX 4 Methodology and Assumptions for Estimating the Impact of HIV/AIDS on Government Budget and Social Insurance Funds

MAIN OBJECTIVES:

1) Estimation of the state budget/special funds revenue forgone due to reduced employment;
2) Estimation of the additional expenditure by the special fund (temporary disability) on temporary disability payments to those infected with HIV; and
3) Estimation of the additional expenditure by the state budget and the special fund (permanent disability) due to an increase in AIDS-related permanent disability cases.

Estimation of the State Budget/Special Funds Revenue Forgone Due to Reduced Employment

The following payroll deductions are made from the salaries of employed persons (see Table A4-1):

- Personal income tax transferred to the state budget (13 percent of wages and salaries);
- Mandatory state pension insurance levy transferred to the pension fund (1-5 percent of salaries);
- Temporary disability insurance levy transferred to the social fund (temporary disability) (0.5-1 percent of salaries);
- Unemployment insurance levy transferred to the social fund (unemployment) (0.5 percent of salaries).

As Table A4-1 shows, the withholding rate for social funds depends on income level. The expert estimate was used to arrive at the average withholding rates of 2 percent for the pension fund and 1 percent for the social insurance fund (temporary disability).

First, the number of employed was estimated under two epidemic scenarios (total and by gender).

Table A4-1. Taxes and Levies on Wages and Income, Ukraine, 2004

	Deductions from wages and salaries	
	Income amount	*Deduction rate*
Personal income tax (state budget)	Any	13%
Pension fund levy		
Public servants	UAH 150-250	1%
	UAH 250-350	2%
	UAH 350-450	3%
	UAH 450-500	4%
	UAH 500+	5%
Other employees	Up to UAH 150	1%
	Above UAH 150	2%
Social insurance fund (temporary disability) levy	Up to UAH 453 (official subsistence level for a working-age person)	0.5%
	Above UAH 453	1%
Social insurance fund (unemployment) levy	Any	0.5%

Source: Ministry of Labor and Social Policies.

Table A4-2. Reduction in Employment from "No-AIDS" Baseline, Two AIDS Scenarios, 2004-14

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1. Optimistic scenario (with AIDS)											
Total (persons)	24,680	37,010	44,853	52,184	70,354	89,997	110,242	130,125	141,100	181,053	195,135
Males	13,192	15,819	17,985	23,694	35,067	52,153	55,263	70,720	83,992	103,588	111,074
Females	11,487	21,191	26,868	28,490	35,286	37,844	54,979	59,404	57,108	77,466	84,061
2. Pessimistic scenario (with AIDS)											
Total (persons)	28,046	42,933	55,621	72,247	100,118	130,389	158,057	199,065	225,470	260,659	309,715
Males	12,271	27,004	35,756	44,999	61,238	81,491	95,725	120,909	140,943	168,784	196,309
Females	15,775	15,929	19,865	27,248	38,880	48,898	62,333	78,155	84,526	91,875	113,406
Difference between scenarios (persons)											
Total	3,366	5,923	10,767	20,063	29,764	40,392	47,816	68,940	84,370	79,606	114,581

Source: Authors' calculations.

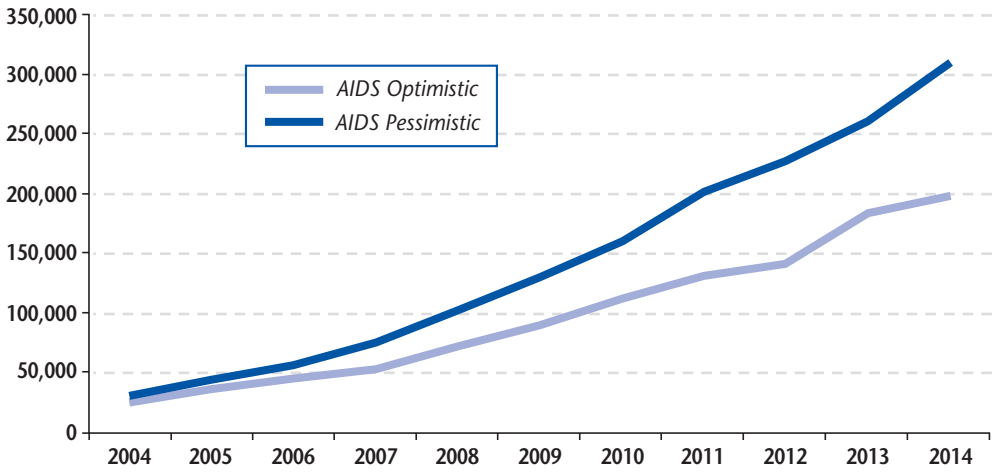
The analysis was conducted by age-gender groups. After taking differences of these projections with the "no-AIDS" projection of employed population, an estimated loss in employment due to the HIV/AIDS epidemic was calculated (for males, females, and total). Table A4-2 reports the final results under two scenarios.

Over the forcast period losses in employment due to HIV/AIDS will increase from 24,000 in 2004 to 195,100 in 2014 in the optimistic, and from 28,100 to 309,700 in the pessimistic scenarios. Under both scenarios the losses among males exceed those among females. Losses under pessimistic scenarios exceed those under optimistic by 114,600 in 2014 (Figure A4-1).

After the reduction in employment is estimated, forgone state budget revenue is calculated as the amount of unpaid personal income tax; forgone pension fund revenue (as unpaid fees for mandatory state pension insurance); the forgone revenue to disability social insurance fund (as unpaid premiums to the fund); and the forgone revenue to unemployment social insurance fund (as unpaid levies to this fund).

Using our estimates of reduction in employment, average withholding rate and average monthly wages, we calculate the resulting forgone revenue

Figure A4-1. Employment Losses from "No-AIDS" Baseline, Two AIDS Scenarios, 2004-14

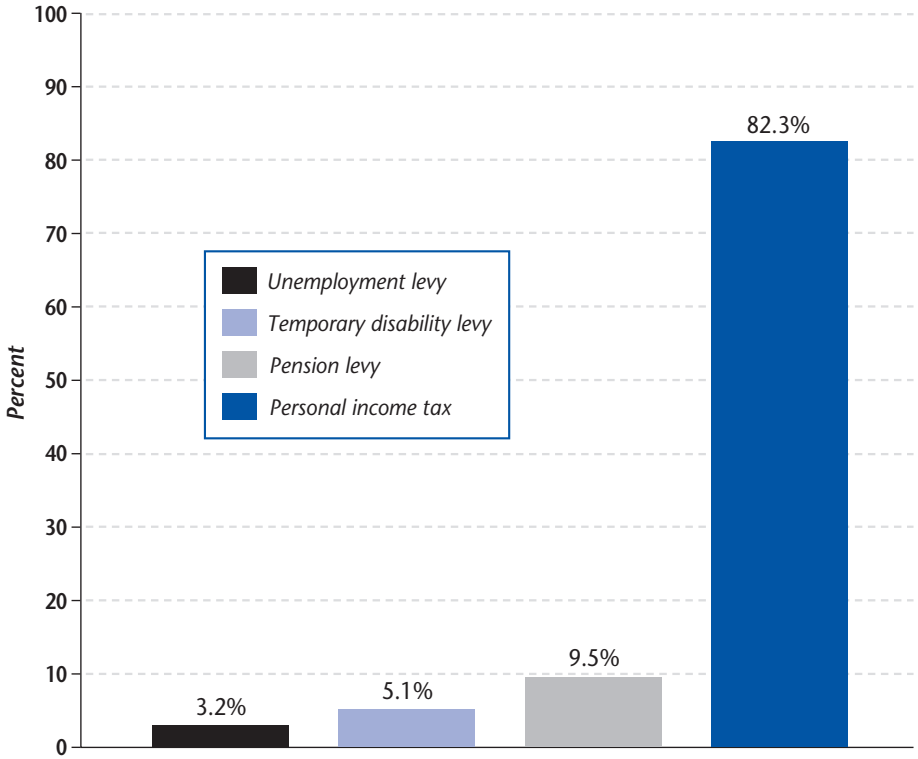


Source: Authors' calculations.

to the state budget and special funds due to HIV/AIDS (in optimistic and pessimistic epidemic scenarios). We also calculate the difference between these scenarios to determine additional forgone revenues to the budget and special funds if the pessimistic epidemic scenario is realized instead of the optimistic one (Table A4-3 on page 66).

Table A4-3 demonstrates that forgone revenue will grow over time as the decline in employment continues, with the amount in forgone taxes increasing 14-fold under the optimistic scenario and more than 19-fold under pessimistic one with respect to the HIV/AIDS epidemic. The structure of total forgone revenue is presented in Figure A4-2.

Figure A4-2. Share of Forgone Revenue due to AIDS by Category, Pessimistic Epidemic Scenario, 2014



Source: Authors' calculations.

Estimated Additional (HIV/AIDS-Related) Temporary Disability Payments from the Special Fund (Temporary Disability)

As part of the Ukrainian legislative package on mandatory state social insurance, the Parliament passed the Law of Ukraine "On mandatory state social insurance in the event of temporary disability and on the expenses associated with births and burials" (18 January 2001, # 2240-III). The law defines legal, organizational, and financial principles of mandatory state social insurance of citizens in the event of temporary disability. In accordance with this law, financial support to those temporarily disabled (including access to social services) is funded through the special fund (temporary disability). This fund is financed through compulsory levies and in 2003 disbursed UAH 1.1 billion in temporary disability benefits. As a consequence of the HIV/AIDS epidemic, an increasing number of employees infected with HIV will take some time off for medical examination and treatment, including hospital inpatient treatment as their disease progresses. As a result, outlays from the special fund on temporary disability benefits will grow.

The number of HIV-infected persons on temporary disability benefit was estimated separately by age-gender group under pessimistic and optimistic epidemic scenarios. This allowed us to compare additional expenditures associated with the realization of the pessimistic scenario as opposed to the optimistic one. We assumed that a person infected with HIV receives his or her temporary disability payment starting Year 5 from becoming infected. For instance, the 2004 estimate of those who apply for a temporary disability benefit for the first time is based on the number of new infections that occurred in 1999. The results are presented in Figures A4-3 and A4-4 on page 67.

According to these figures, the estimated number of persons on disability benefit diverges in 2008, assuming that 2004-08 payments are made to those who

Table A4-3. Forgone Revenue to the State and Special Funds Budgets due to a Reduction in Employment Caused by HIV/AIDS, 2004-14

In hryvnia

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1. Optimistic scenario (with AIDS)											
Unpaid personal income tax	15,469,349	26,957,019	34,400,899	42,104,805	59,659,891	80,133,264	102,772,447	126,767,179	143,645,330	192,613,598	216,935,429
Unpaid state pension insurance levy	1,784,925	3,110,425	3,969,334	4,858,247	6,883,834	9,246,146	11,858,359	14,629,982	16,574,461	22,224,646	25,031,017
Unpaid social insurance (temporary disability) levy	1,024,566	1,670,149	2,131,342	2,608,645	3,696,288	4,964,736	6,367,369	7,853,986	8,899,689	11,933,566	13,440,453
Unpaid social insurance (unemployment) levy	594,975	1,036,808	1,323,111	1,619,416,	2,294,611	3,082,049	3,952,786	4,875,661	5,524,820	7,408,215	8,343,672
2. Pessimistic scenario (with AIDS)											
Unpaid personal income tax	17,579,272	31,271,121	42,659,161	58,292,315	84,900,074	116,097,889	147,348,389	193,928,468	229,536,709	277,302,374	344,317,372
Unpaid state pension insurance levy	2,028,377	3,608,206	4,922,211	6,726,036	9,796,162	13,395,910	17,001,737	22,376,362	26,485,005	31,996,428	39 728 928
Unpaid social insurance (temporary disability) levy	1,164,310,	1,937,433	2,642,991	3,611,558	5,260,068	7,192,960	9,129,116	12,015,031	14,221,174	17,180,543	21,332,524
Unpaid social insurance (unemployment) levy	676,126	1,202,735	1,640,737	2,240,012	3,265,387	4,465,303,	5,667,246	7,458,787	8,828,335	10,665,476	13,242,976
3. Difference between scenarios	2,574,271	5,245,094	10,040,413	19,680,810	30,687,068	43,725,868	54,195,526	81,654,840	104,426,923	102,964,796	154,871,179
Unpaid personal income tax	2,109,923	4,314,102	8,258,262	16,187,510	25,240,183	35,964,625	44,575,942	67,161,289	85,891,379	84,688,776	127,381,893
Unpaid state pension insurance levy	243,453	497,781	952,876	1,867,790	2,912,329	4,149,764	5,143,378	7,749,380	9,910,544	9,771,782	14,697,911
Unpaid social insurance (temporary disability) levy	139,744	267,284	511,649	1,002,913	1,563,781	2,228,224	2,761,747	4,161,044	5,321,486	5,246,977	7,892,071
Unpaid social insurance (unemployment) levy	81,151	165,927	317,625	622,597	970,776	1,383,255	1,714,459	2,583,127,	3,303,315	3,257,261	4,899,304

Source: Authors' calculations.

contracted the infection in 1999-2003 in the medium epidemic scenario. Overall, 721,100 HIV-infected persons will receive temporary disability benefit over 2004-14 in the pessimistic scenario and 524,000 in the optimistic one.

To evaluate the monetary value of the additional disability payments, we made several assumptions:

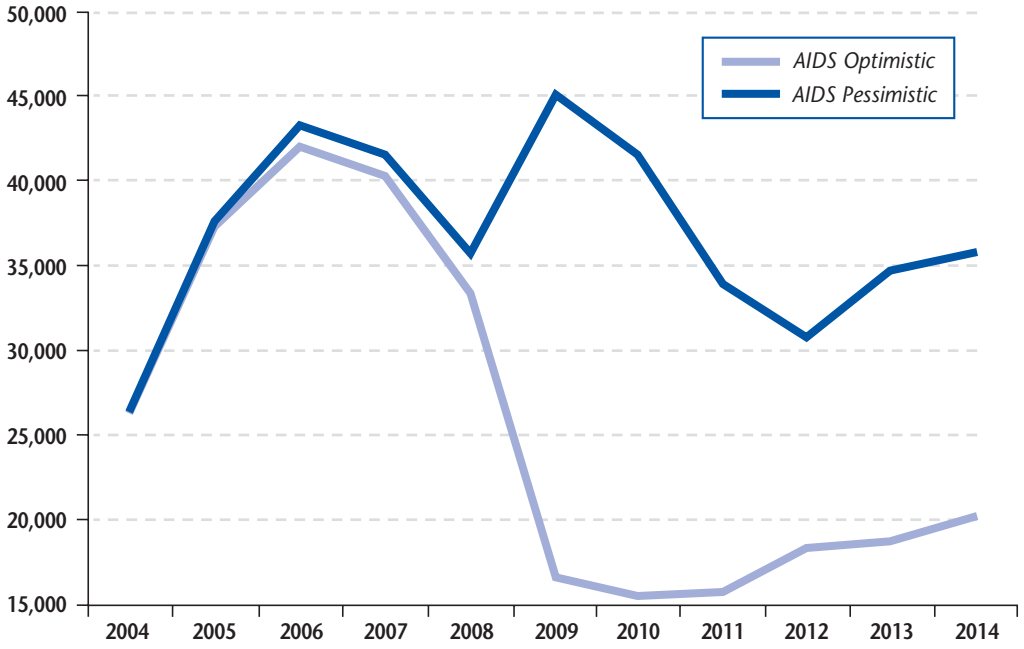
1) We assume that all those infected with HIV receive money from the social insurance special funds. This assumption provides an upper estimate of the fund's potential additional expenditure associated with HIV/AIDS;

2) In line with historic data, the average number of sick days per person per year is 3.9;

3) Based on the same data for 2003, an average temporary disability benefit is UAH 22.41, which is assumed to be applicable to those requiring this benefit because of their HIV status;

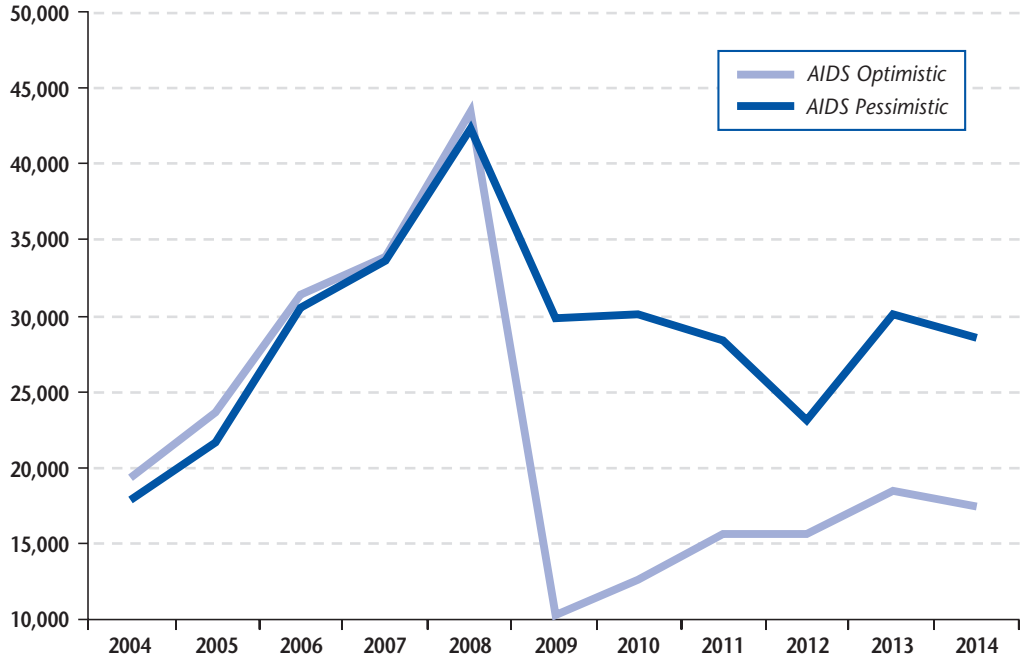
4) Average daily wages and salaries are assumed to be UAH 23.75, based on the fund's 2003 annual report. This is the basis for calculating the temporary disability benefit amount in lieu of actual data on average monthly earnings of those infected with HIV.

Figure A4-3. Estimated New Male Recipients of Temporary Disability Payments due to HIV, 2004-14



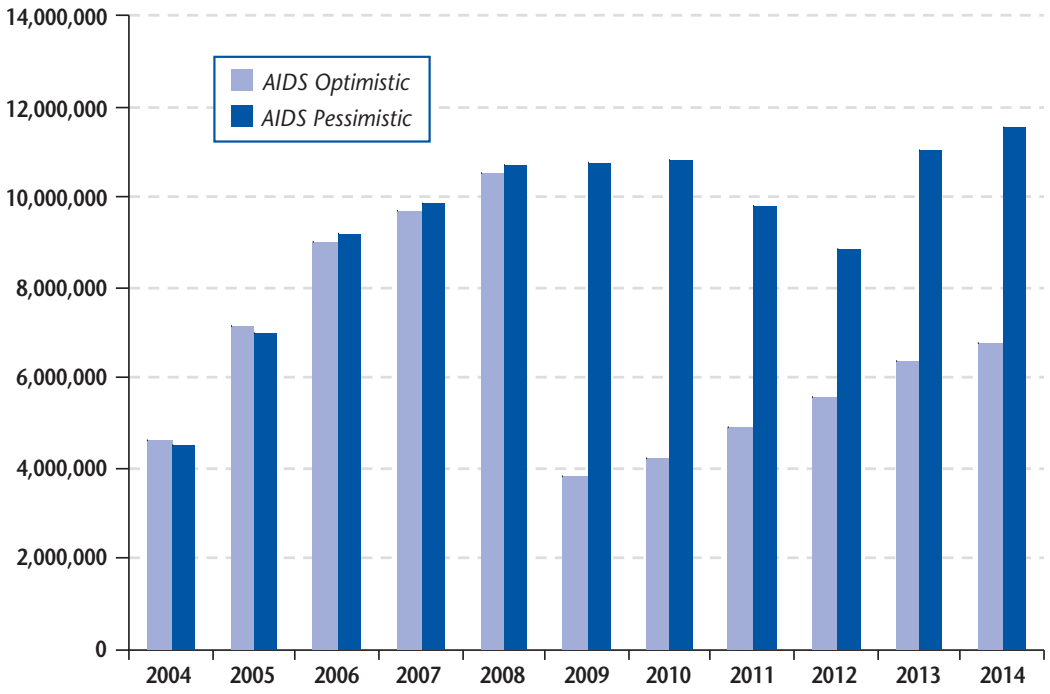
Source: Authors' calculations.

Figure A4-4. Estimated New Female Recipients of Temporary Disability Payments due to HIV, 2004-14



Source: Authors' calculations.

Figure A4-5. Outlays in Temporary Disability Associated with HIV/AIDS, 2004-14



Source: Authors' calculations.

Future disability benefits up to 2014 are indexed in accordance with the projected average monthly wages and salaries for the same period. Total amount of temporary disability benefit is calculated as a product of the total number of HIV-infected persons requiring a benefit in a relevant year, adjusted for an unemployment, times average daily wages and salaries adjusted for inflation, times the number of sick days per patient and the index of substitution for temporary disability. The results are presented in Table A4-4. They include an estimated additional expenditure on temporary disability payments through the special fund due to HIV/AIDS, total and by gender, under two epidemic scenarios. The difference between the pessimistic and optimistic scenarios demonstrates savings to the special fund (temporary disability) if the pessimistic scenario is avoided.

Based on the methodology discussed above, temporary disability outlays under pessimistic and optimistic scenarios diverge considerably from 2009 (Figure A4-5).

Estimated Additional Payments from the Special Fund (Permanent Disability) to Those Disabled due to AIDS

According to Ukrainian law, disabled persons receive the following payments and allowances:

- Disability pensions from the Pension Fund of Ukraine;
- Financial support from the special fund (permanent disability) and allowances for additional social services;
- State social assistance to disabled children and persons disabled from childhood provided from the State budget.

Permanent Disability Pensions

To calculate additional permanent disability pensions, we used the projected number of new AIDS cases as the number of new recipients of the permanent disability payments and allowances. Total estimated additional expenditure on permanent

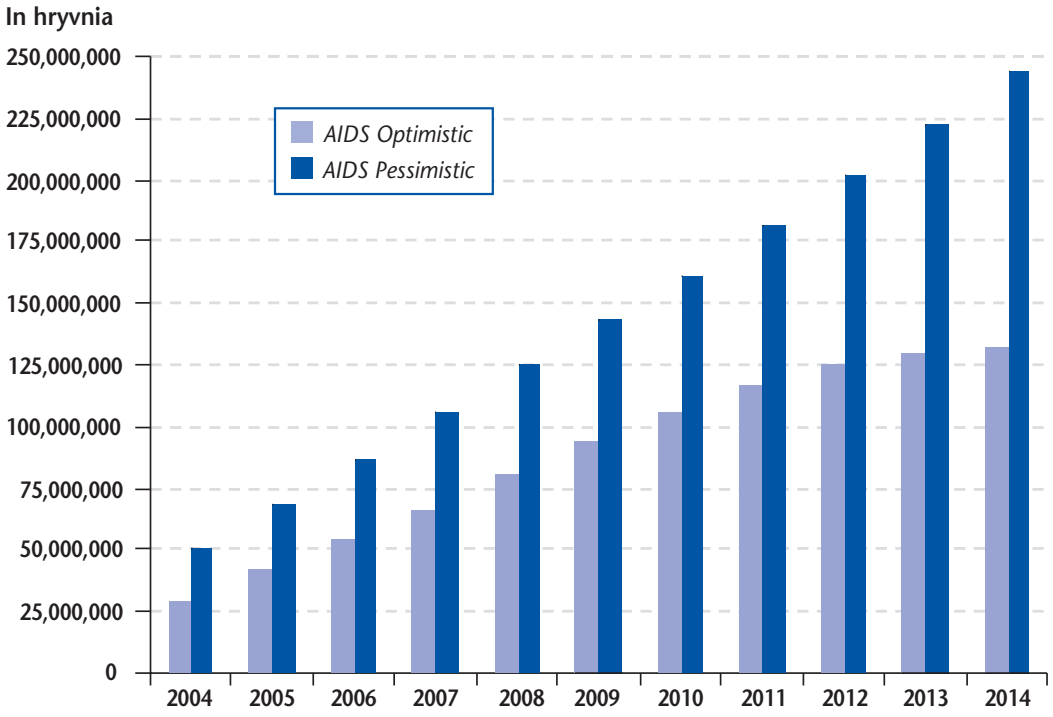
Table A4-4. Estimated Additional (HIV/AIDS-Related) Temporary Disability Payments from the Special Fund (Temporary Disability), 2004-14

In hryvnia

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Pessimistic scenario (pI)	4,493,262	6,965,999	9,145,136	9,829,175	10,657,932	10,717,548	10,781,667	9,775,011	8,836,940	11,045,756	11,532,042
Optimistic scenario (oI)	4,630,955	7,157,767	9,011,341	9,642,809	10,531,916	3,815,574	4,192,201	4,874,917	5,558,031	6,349,419	6,769,822
Difference between pessimistic and optimistic scenarios			133,795	186,366	126,016	6,901,974	6,589,466	4,900,094	3,278,909	4,696,336	4,762,220
PESSIMISTIC SCENARIO											
Total,additional, expenditures, (pI)	4,493,262	6,965,999	9,145,136	9,829,175	10,657,932	10,717,548	10,781,667	9,775,011	8,836,940	11,045,756	11,532,042
Males	2,684,010	4,418,808	5,354,277	5,430,678	4,862,570	6,444,623	6,247,645	5,334,399	5,028,538	5,940,445	6,394,519
Females	1,809,252	2,547,102	3,790,858	4,398,497	5,765,362	4,272,925	4,534,022	4,440,612	3,808,402	5,105,311	5,137,523
Projected number of recipients of temporary disability benefit due to HIV/AIDS, total (persons)	44,380	59,220	73,820	75,420	77,810	74,520	71,600	62,110	53,730	64,280	64,210
Males	26,510	37,560	43,220	41,670	35,500	44,810	41,490	33,900	30,580	34,570	35,610
Females	17,870	21,650	30,600	33,750	42,310	29,710	30,110	28,220	23,160	29,710	28,610
Average annual benefit per person	101.25	117.65	123.88	130.33	136.97	143.82	150.58	157.36	164.44	171.84	179.57
OPTIMISTIC SCENARIO											
Total additional expenditures (oI)	4,630,955	7,157,767	9,011,341	9,642,809	10,531,916	3,815,574	4,192,201	4,874,917	5,558,031	6,349,419	6,769,822
Males	2,681,985	4,391,838	5,180,840	5,233,886	4,583,144	2,370,172	2,306,162	2,450,047	3,005,119	3,204,781	3,625,536
Females	1,948,970	2,765,929	3,830,501	4,408,923	5,948,773	1,445,402	1,886,039	2,424,870	2,552,912	3,144,638	3,144,286
Projected number of recipients of temporary disability benefit due to HIV/AIDS, total (persons)	45,740	60,840	72,740	73,990	76,890	26,530	27,840	30,980	33,800	36,950	37,700
Males	26,490	37,330	41,820	40,160	33,460	16,480	15,315	15,570	18275	18,650	20,120
Females	19,250	23,510	30,920	33,830	43,430	10,050	12,525	15,410	15,525	18,300	17,510
Average annual benefit per person	101.25	117.65	123.88	130.33	136.97	143.82	150.58	157.36	164.44	171.84	179.57

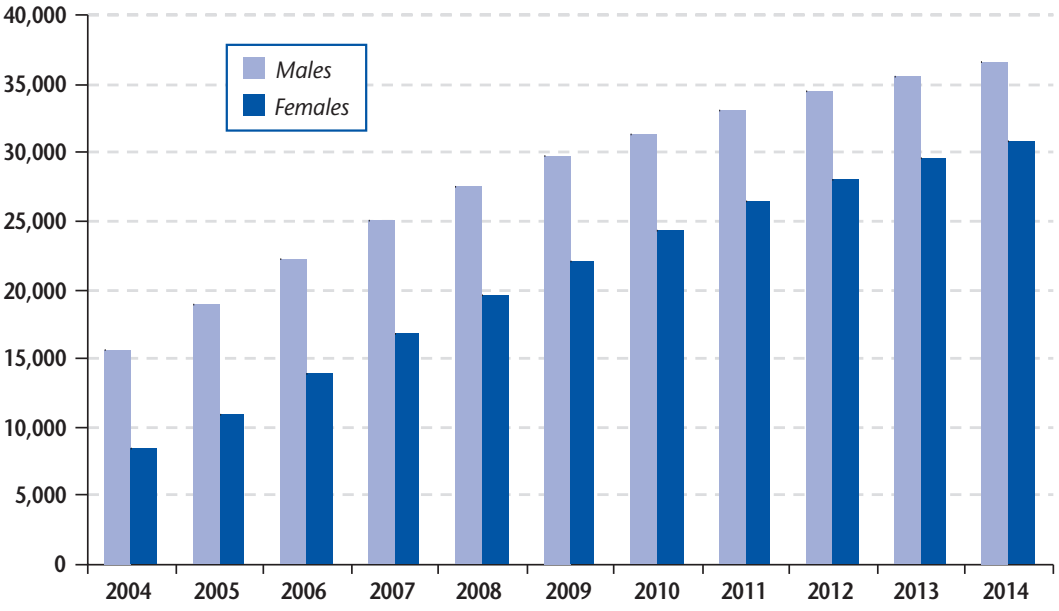
Source: Authors' calculations.

Figure A4-6. Estimated Additional Expenditure on Permanent Disability Pensions due to AIDS, 2004-14



Source: Authors' calculations.

Figure A4-7. Estimated Number Disabled due to AIDS, by Gender, 2004-14



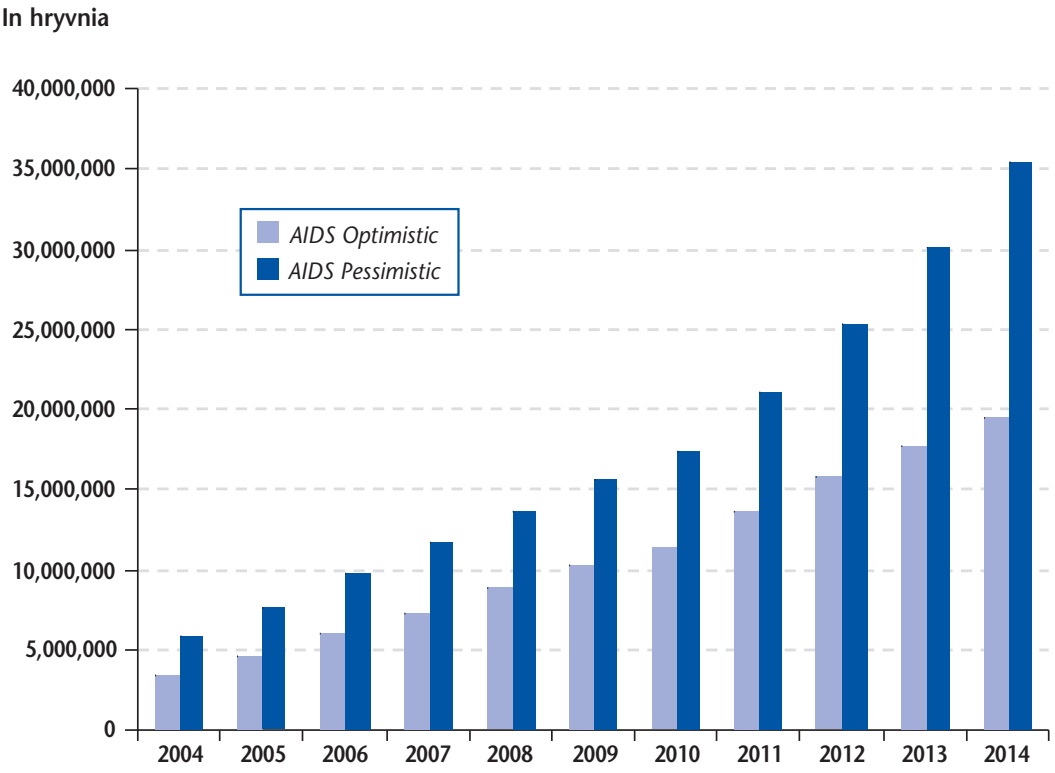
Source: Authors' calculations.

disability pensions due to AIDS is presented in Figure A4-6.

To construct this estimate, we used the projected new AIDS cases under two epidemic scenarios and the actual average disability pension adjusted for projected inflation. Figure A4-7 presents the estimated number disabled as a result of AIDS in pessimistic scenario, by gender.

We estimate that in 2005 additional disability pension payments due to AIDS will total UAH 57.8 million under the pessimistic scenario and 35.3 million under the optimistic one. In the former, the disability pension outlays will increase to UAH 199.9 million in 2014, corresponding to an 15 percent per annum growth rate. In the latter, these payments will reach UAH 109.2 million, a 13 percent per annum increase over 2005-14 (Figure A4-5). Results of calculation are presented in Table A4-5 on page 73.

Figure A4-8. Estimated Additional Financial Assistance and Allowances Provided by the Special Fund (Permanent Disability) to Those Disabled due to AIDS, 2004-14



Source: Authors' calculations.

Financial Support from the Special Fund (Permanent Disability) and Allowances for Additional Social Services

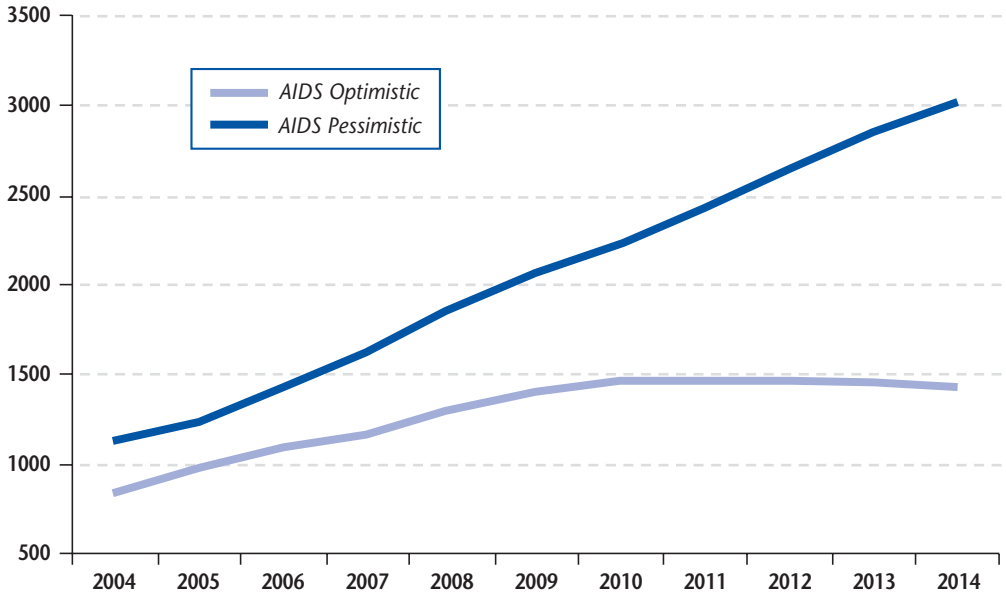
Pursuant to Ukraine's law "On basic principles of social protection of disabled persons in Ukraine," disabled persons have the right to receive financial support and allowances for health and social services from the special fund (permanent disability). To estimate additional outlays by the fund due to the HIV/AIDS epidemic, we used the projected new AIDS cases occurring among those aged 15 and above separately for males and females. This was taken as an estimate of the number of recipients of financial support and allowances from the special fund (permanent disability). An annual allowance covering provision of medical and social services to a person disabled is calculated and adjusted for future inflation.

We estimate that in the pessimistic scenario the total additional expenditure from the special fund (permanent disability) due to AIDS amounts to UAH 5.8 million in 2005, UAH 17.3 million in 2010, and UAH 35.5 million in 2014, representing a 3-7 percent increase in total fund expenditure. Figure A4-8 and Table A4-5 present the results under both scenarios.

Additional Assistance to Disabled Children and Persons Disabled Since Childhood Provided from the State Budget

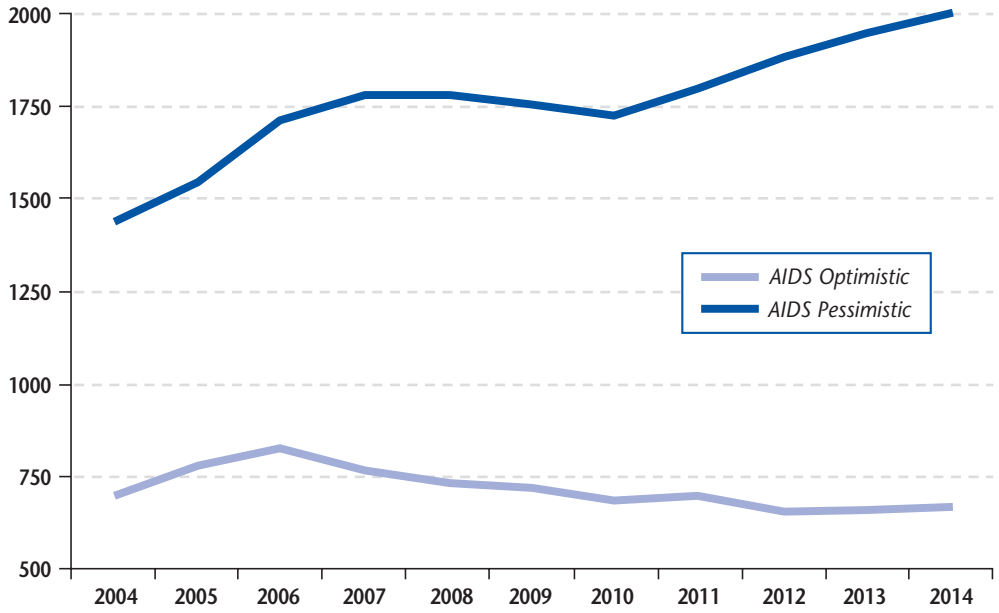
To calculate the amount of additional assistance from the state budget to children disabled due to AIDS, we assumed that all children who developed

Figure A4-9. Projected Number of Disabled Children (0-16) Receiving Assistance due to Their AIDS Condition, 2004-14



Source: Authors' calculations.

Figure A4-10. Projected Number of Persons Disabled Since Childhood (AIDS Patients Aged 17-21) Receiving Assistance under Optimistic and Pessimistic Scenarios, 2004-14



Source: Authors' calculations.

AIDS when they are 16 or younger, as well as adults who were infected with HIV in their childhood become disabled. In accordance with the Ukraine law "On state social aid to persons disabled since childhood and disabled children," these categories of population have the right to receive state assistance provided from the state budget.

To estimate the number of recipients in this category, we used the projected number of AIDS cases in the 0-16 age group and added cases in the 17-21 age group. This selection is based on the assumption that progression from infection with HIV at age 16 and younger to AIDS takes five years on average. Figures A4-9 and A4-10 illustrate our estimate of the number of disabled children and those disabled since childhood under both epidemic scenarios. Total additional assistance to disabled children and those disabled since childhood as a result of AIDS was calculated and inflated using CPI. Results are presented in Table A4-5.

Table A4-5. Estimated Additional Permanent Disability Payments from State Budget and Special Funds due to HIV/AIDS, 2004-2014

In hyvnia

Estimated Additional Expenditure due to AIDS, total											
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
PESSIMISTIC scenario *(pI+pII+pIII)*	50,917,910	68,509,962	86,844,409	105,658,679	124,642,174	143,539,156	161,639,414	181,677,295	201,945,767	222,333,806	243,718,083
OPTIMISTIC scenario *(oI+oII+oIII)*	29,379,285	41,782,943	54,486,002	66,616,407	80,323,018	93,979,824	105,609,184	116,201,415	124,491,751	129,754,108	132,199,118
INCLUDING:											
Estimated additional disability pensions due to AIDS, from the Pension Fund											
PESSIMISTIC											
Total (pI)	42,564,282	57,814,746	73,632,949	89,951,537	106,486,808	122,975,600	138,849,521	154,474,018	169,835,471	184,730,776	199,909,417
Males	27,695,446	36,647,811	45,336,244	53,927,780	62,323,235	70,486,014	78,135,568	85,949,125	93,627,247	100,969,093	108,574,056
Females	14,868,836	21,166,934	28,296,706	36,023,757	44,163,573	52,489,585	60,713,953	68,524,893	76,208,224	83,761,684	91,335,361
Number of recipients, total (persons)	23,760	29,690	35,910	41,690	46,970	51,660	55,710	59,310	62,400	64,950	67,260
Males	15,460	18,820	22,110	25,000	27,490	29,610	31,350	33,000	34,400	35,500	36,530
Females	8,300	10,870	13,800	16,700	19,480	22,050	24,360	26,310	28,000	29,450	30,730
Average payment pa	1,791	1,947	2,050	2,157	2,267	2,380	2,492	2,605	2,722	2,844	2,972
OPTIMISTIC											
Total (oI)	24,542,536	35,265,242	46,279,467	56,969,307	68,965,908	80,936,322	91,245,395	99,466,578	105,466,739	108,591,548	109,198,216
Males	14,743,436	20,738,533	26,738,336	32,723,377	38,971,859	44,967,268	50,171,259	54,069,813	56,611,824	57,395,952	57,184,912
Females	9,799,100	14,526,709	19,541,131	24,245,930	29,994,049	35,969,054	41,074,136	45,396,765	48,854,915	51,195,596	52,013,304
Number of recipients, total (persons)	13,700	18,110	22,580	26,410	30,420	33,990	36,600	38,190	38,760	38,180	36,740
Males	8,230	10,650	13,040	15,170	17,190	18,890	20,130	20,760	20,800	20,180	19,240
Females	5,470	7,460	9,530	11,240	13,230	15,110	16,480	17,430	17,950	18,000	17,500
Average payment pa	1,791	1,947	2,050	2,157	2,267	2,380	2,492	2,605	2,722	2,844	2,972

(continued on page 74)

Table A4-5.Estimated Additional Permanent Disability Payments from State Budget and Special Funds due to HIV/AIDS, 2004-2014

(continued from page 73)

Estimated additional financial assistance from the Special Funds due to AIDS											
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
PESSIMISTIC SCENARIO											
Total (pII)	5,833,690	7,681,836	9,656,184	11,663,319	13,630,381	15,543,178	17,328,395	21,061,091	25,282,165	30,047,236	35,480,773
Males	3,816,696	4,889,418	5,967,399	7,012,498	7,992,716	8,916,169	9,748,637	11,706,761	13,911,098	16,390,278	19,227,473
Females	2,016,995	2,792,419	3,688,785	4,650,821	5,637,665	6,627,009	7,579,759	9,354,330	11,371,067	13,656,958	16,253,301
Number of recipients, total (persons)	22,800	28,590	34,600	40,190	45,260	49,750	53,610	57,000	59,940	62,310	64,420
Males	14,930	18,210	21,370	24,170	26,540	28,550	30,160	31,700	32,970	34,000	34,910
Females	7,890	10,400	13,210	16,030	18,720	21,220	23,450	25,330	26,950	28,330	29,510
Average payment pa	256	269	279	290	301	312	323	369	422	482	551
OPTIMISTIC SCENARIO											
Total (oII)	3,307,973	4,628,971	6,020,455	7,337,446	8,787,771	10,202,846	11,380,951	13,586,490	15,771,818	17,773,810	19,530,398
Males	2,001,656	2,738,718	3,496,108	4,230,129	4,978,131	5,683,863	6,260,978	7,382,276	8,451,298	9,371,383	10,183,786
Females	1,306,317	1,890,253	2,524,346	3,107,317	3,809,640	4,518,983	5,119,974	6,204,214	7,320,520	8,402,428	9,346,612
Number of recipients, total (persons)	12,940	17,240	21,550	25,300	29,160	32,640	35,210	36,800	37,380	36,840	35,480
Males	7,830	10,200	12,520	14,580	16,530	18,200	19,370	19,990	20,030	19,440	18,490
Females	5,110	7,040	9,040	10,710	12,650	14,470	15,840	16,800	17,350	17,430	16,970
Average payment pa	256	269	279	290	301	312	323	369	422	482	551
Estimated additional financial assistance from State budget to disabled children and persons disabled since childhood due to AIDS (UAH)											
2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	
PESSIMISTIC SCENARIO											
Total (UAH) - (pIII)	2,519,937	3,013,380	3,555,276	4,043,823	4,524,985	5,020,378	5,461,497	6,142,186	6,828,132	7,555,793	8,327,893
Total assistance to disabled children	1,179,091	1,442,448	1,727,174	2,052,624	2,442,418	2,849,616	3,224,794	3,707,424	4,165,930	4,673,155	5,241,768

Table A4-5.Estimated Additional Permanent Disability Payments from State Budget and Special Funds due to HIV/AIDS, 2004-2014

(continued from page 73)

Total assistance to persons disabled since childhood	1,340,846	1,570,932	1,828,101	1,991,199	2,082,567	2,170,762	2,236,703	2,434,762	2,662,202	2,882,638	3,086,125
Number of disabled children (0-16) due to AIDS, total (persons)	1,132	1,272	1,448	1,640	1,852	2,056	2,232	2,452	2,638	2,824	3,044
Number of persons disabled since childhood (17-21) due to AIDS, total (persons)	1,436	1,546	1,710	1,774	1,762	1,748	1,726	1,796	1,880	1,944	1,998
Average assistance pa:											
Disabled children	1,042	1,134	1,193	1,252	1,319	1,386	1,445	1,512	1,579	1,655	1,722
Persons disabled since childhood	934	1,016	1,069	1,122	1,182	1,242	1,296	1,356	1,416	1,483	1,545
OPTIMISTIC SCENARIO											
Total (UAH) - (oIII)	1,528,775	1,888,730	2,186,080	2,309,655	2,569,339	2,840,656	2,982,837	3,148,347	3,253,195	3,388,750	3,470,504
Total assistance to disabled children	877,027	1,102,248	1,307,309	1,454,359	1,706,527	1,951,488	2,109,408	2,207,520	2,321,424	2,416,008	2,441,796
Total assistance to persons disabled since childhood	651,748	786,482	878,771	855,295	862,812	889,168	873,429	940,827	931,771	972,742	1,028,708
Number of disabled children (0-16) due to AIDS, total (persons)	842	972	1,096	1,162	1,294	1,408	1,460	1,460	1,470	1,460	1,418
Number of persons disabled since childhood (17-21) due to AIDS, total (persons)	698	774	822	762	730	716	674	694	658	656	666
Average assistance pa:											
Disabled children	1,042	1,134	1,193	1,252	1,319	1,386	1,445	1,512	1,579	1,655	1,722
Persons disabled since childhood	934	1,016	1,069	1,122	1,182	1,242	1,296	1,356	1,416	1,483	1,545

Note: "Pa" is per annum, or per year

Source: Authors' calculations.

ANNEX 5 Growth Model: Methodology and Assumptions

This simple aggregate, two-factor, closed-economy macroeconomic model is analogous in its structure to the World Bank model designed for the Russian Federation by Ruehl, Pokrovsky and Vinogradov (2002). The major distinction is that unlike the Russian model, the Ukrainian model does not generate the population and epidemic dynamics within the model. Demographic and epidemiological forecasts reported in Chapter 3 and the labor force forecasts of Chapter 4 are used as inputs into the following macroeconomic model. Number of ARV therapy recipients and total expenditure on AIDS hospitalization and treatment are also determined outside the model: these series are outputs from the AIM model and are exogenous to the macroeconomic model.

Model Description

The output Y_t is a function of labor L_t and capital K_t with the Cobb-Douglas production function:

$$Y_t = A_t \cdot K_t^{\alpha} \cdot L_t^{\beta},$$

A_t is the total factor productivity (TFP). The value of capital share is assumed at $\alpha = 0.3$, and the labor share $\beta = 0.7$. The TFP is assumed to be growing from 1 percent to 5 percent over 2004-14. All these parameters are open to manipulation by users as the model is coded in an Excel spreadsheet.

The growth rate of capital is by gross investment net of depreciation:

$$K_t = K_{t-1} \cdot (1-\delta) + I_{t-1}$$

where the depreciation rate is parameterized as $\delta = 0.05$ but can be changed by the user.

Investment consists of public (government) and private investment. Investment equals savings; government as well as household consumption becomes the residual of aggregate output:

$$I_t = I_t^{private} + I_t^{public}$$

$$I_t = S_t$$

$$Y_t = C_t + S_t$$

The tax rate τ can be defined by the user. As a percentage of output, private investments are defined as follows:

$$I_t^{private} = s_t^{private} \cdot (1-\tau) \cdot Y_t$$

As a percentage of output, public investments are defined as

$$I_t^{public} = s^{public} \cdot \max(0, CBS_t)$$

Here s^{public} denotes the share of public investment, and CBS_t is current budget surplus. Current budget surplus is defined as the tax revenues, $\tau \cdot Y_t$, net of debt payment and minimum required public expenditures (MPE_t) (all user-defined parameters), as well as the cost of antiretroviral therapy (defined as unit cost per annum, ARV_Cost, times the number receiving ARV therapy, $ARV\_Recipients$) and AIDS treatment ($AIDS\_Care$, projected from AIM according to two epidemic and three cost scenarios). The budget level, B, is

$$B_t = \tau \cdot Y_t - I_t^{public} - (1+i) \cdot D_{t-1} - MPE_t - ARV\_Cost * ARV\_Recipients_t - AIDS\_Care_t$$

Current budget deficit results in a debt D, the debt service is included in the next year budget.

Model Application

We applied the model under three demographic scenarios (benchmark "no-AIDS" and two epidemic scenarios: "AIDS Optimistic" and "AIDS Pessimistic")

and three cost scenarios (ARV Low-HOSP(italization) Low, ARV High-HOSP Low, and ARV High-HOSP High). Model parameters and implications are presented in Tables A5-1 and A5-2 on page 78.

Recall that the epidemic scenarios used in the modelling of Chapter 3 are based on the following assumptions about availability of ARV therapy:

- The "AIDS medium" scenario assumes that in 2004, 1 percent of those in need of ARV therapy have access to it, with the proportion receiving it rising to 10 percent in 2008 and remaining at that level thereafter;
- The "AIDS optimistic" scenario assumes that in 2004, 1 percent of those in need of ARV therapy have access to it, with the proportion receiving it rising to 30 percent in 2010 and then to 50 percent in 2014;
- The "AIDS pessimistic" scenario assumes that in 2004, 1 percent of those in need of ARV therapy have access to it, with the proportion receiving it rising to 5 percent in 2005 and remaining at that level thereafter.

The optimistic scenario also assumes lower MTCT rates starting in 2004 than the pessimistic scenario. We considered three plausible cost scenarios, reflecting the degree of uncertainty with respect to the cost of treatment and access to treatment by those who require it:

Scenario A. ARV-low, Hospitalization-Low: Assumes availability of low-price ARV treatment (UAH 1,500 per year in constant prices[19]) throughout the modelling horizon. It is also assumed that starting from 0 percent in 2004, 30 percent of AIDS cases are hospitalized by 2014, at an annual cost of UAH 1,500 per case;

Scenario B. ARV-High, Hospitalization-Low. Assumes that the cost of an ARV treatment per year is UAH 7,500 in constant prices throughout the modelling horizon; 50 percent of AIDS cases are hospitalised by 2014, at an annual cost of UAH 7,500 per case;

Scenario C. ARV-High, Hospitalization-High. Assumes that the cost of an ARV treatment per year is UAH 7,500 in constant prices throughout the modelling horizon; 100 percent of AIDS cases are hospitalised by 2014, at an annual cost of UAH 7,500 per case.

Table A5-1. Simple Growth Model Parameters for Various Scenarios

In hryvnia

MODEL PARAMETERS	No-AIDS	Low	High
HIV treatment costs scenarios			
Annual cost of ARV medication per HIV+ receipient	0	1500	7500
Economy			
Public investment as % of government revenue	8.1	8.1	8.1
Private saving (investment) as % of after-tax income	30	30	30
Domestic interest rate, %, i	5	5	5
Household tax rate, %, tau	26	26	26
Miscellaneous			
Budgetary costs of HIV prevention programs, billion UAH	0.01	0.01	0.01
Minimum public expenditure as % of GDP, MPE	10	10	10
Depreciation rate, delta, %	5	5	5
Capital share, alpha (CRS function)	0.3	0.3	0.3
Public debt, % DP	29	29	29

Source: State Statistics Committee of Ukraine, Ministry of Health, WHO (Kiev office), estimates of the Institute for Economic Forecasting of the Academy of Sciences of Ukraine, and authors' calculations.

[19] Data supplied by WHO Kiev Office, based on the Clinton Foundation best negotiated price for generics. Exchange rate 1US$ = 5.3 UAH.

Table A5-2. Simple Growth Model Output, AIDS/Cost Scenario Analysis

	A. ARV low -H low			B. ARV high -H low			C. ARV high -H high		
	2004	*2014*	*Diff(Base)*	*2004*	*2014*	*Diff(Base)*	*2004*	*2014*	*Diff(Base)*
Output (billion UAH)									
No AIDS	345.94	359.64	0.00	345.94	359.64	0.00	345.94	359.64	0.00
AIDS optimistic	345.94	357.09	-2.54	345.94	357.08	-2.55	345.94	357.08	-2.56
AIDS pessimistic	345.94	355.20	-4.44	345.94	355.19	-4.45	345.94	355.19	-4.45
Output (Index, 2004=100)									
No AIDS	100.00	103.96	0.00	100.00	103.96	0.00	100.00	103.96	0.00
AIDS optimistic	100.00	103.22	-0.74	100.00	103.22	-0.74	100.00	103.22	-0.74
AIDS pessimistic	100.00	102.68	-1.28	100.00	102.67	-1.29	100.00	102.67	-1.29
Output per capita (Index, 2004=100)									
No AIDS	100.00	110.80	0.01	100.00	110.80	0.00	100.00	110.80	0.00
AIDS optimistic	100.06	110.79	-0.01	100.06	110.79	-0.01	100.06	110.79	-0.01
AIDS pessimistic	100.13	110.00	-0.80	100.13	110.78	-0.02	100.13	110.78	-0.02
GDP growth rate, %		*Average*							
No AIDS	12.10%	0.10%	1.45%	12.10%	0.10%	1.45%	12.10%	0.10%	1.45%
AIDS optimistic	12.10%	0.02%	1.39%	12.10%	0.02%	1.39%	12.10%	0.02%	1.39%
AIDS pessimistic	12.10%	-0.13%	1.34%	12.10%	-0.13%	1.34%	12.10%	-0.13%	1.34%
GDP per capita growth rate, %		*Average*							
No AIDS	10.00%	0.64%	1.85%	10.00%	0.64%	1.85%	10.00%	0.64%	1.85%
AIDS optimistic	10.00%	0.66%	1.84%	10.00%	0.66%	1.84%	10.00%	0.66%	1.84%
AIDS pessimistic	10.00%	-0.13%	1.77%	10.00%	0.58%	1.83%	10.00%	0.58%	1.83%
Capital stock (billion UAH)									
No AIDS	1,032.04	1,290.01	0.00	1,032.04	1,290.01	0.00	1,032.04	1,290.01	0.00
AIDS optimistic	1,032.04	1,288.09	-1.92	1,032.04	1,287.97	-2.04	1,032.04	1,287.93	-2.08
AIDS pessimistic	1,032.04	1,286.77	-3.24	1,032.04	1,286.69	-3.32	1,032.04	1,286.62	-3.39
Capital stock (Index, 2004=100)									
No AIDS	100.00	125.00	0.00	100.00	125.00	0.00	100.00	125.00	0.00
AIDS optimistic	100.00	124.81	-0.19	100.00	124.80	-0.20	100.00	124.80	-0.20
AIDS pessimistic	100.00	124.68	-0.31	100.00	124.67	-0.32	100.00	124.67	-0.33
Effective labor supply (million persons)									
No AIDS	20.44	18.31	0.00	20.44	18.31	0.00	20.44	18.31	0.00
AIDS optimistic	20.42	18.12	-0.20	20.42	18.12	-0.20	20.42	18.12	-0.20
AIDS pessimistic	20.43	18.00	-0.31	20.43	18.00	-0.31	20.43	18.00	-0.31

(continued on page 79)

Table A5-2. Simple Growth Model Output, AIDS/Cost Scenario Analysis *(continued from page 78)*

	A. ARV low -H low			B. ARV high -H low			C. ARV high -H high		
	2004	*2014*	*Diff(Base)*	*2004*	*2014*	*Diff(Base)*	*2004*	*2014*	*Diff(Base)*
Effective labor supply (Index, 2004=100)									
No AIDS	100.00	89.60	0.00	100.00	89.60	0.00	100.00	89.60	0.00
AIDS optimistic	99.88	88.64	-0.95	99.88	88.64	-0.95	99.88	88.64	-0.95
AIDS pessimistic	99.96	88.08	-1.52	99.96	88.08	-1.52	99.96	88.08	-1.52
Investment (billion UAH)									
No AIDS	82.29	84.50	0.00	82.29	84.50	0.00	82.29	84.50	0.00
AIDS optimistic	82.29	83.90	-0.60	82.29	83.86	-0.64	82.29	83.85	-0.65
AIDS pessimistic	82.29	83.45	-1.05	82.29	83.43	-1.07	82.29	83.41	-1.09
Investment (Index, 2004=100)									
No AIDS	100.00	102.69	0.00	100.00	102.69	0.00	100.00	102.69	0.00
AIDS optimistic	100.00	101.96	-0.74	100.00	101.91	-0.78	100.00	101.90	-0.79
AIDS pessimistic	100.00	101.42	-1.27	100.00	101.39	-1.30	100.00	101.37	-1.33
Cumulative HIV+ (thousands)									
No AIDS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIDS optimistic	447.78	478.50	478.50	447.78	478.50	478.50	447.78	478.50	478.50
AIDS pessimistic	491.16	820.42	820.42	491.16	820.42	820.42	491.16	820.42	820.42
Public expenditure on ARV (million UAH)									
No AIDS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIDS optimistic	0.41	70.61	70.61	2.03	353.03	353.03	2.03	353.03	353.03
AIDS pessimistic	0.72	10.38	10.38	3.60	51.90	51.90	3.60	51.90	51.90
Public expenditure on AIDS care (million UAH)									
No AIDS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIDS optimistic	0.00	16.55	16.55	0.00	137.88	137.88	0.00	275.76	275.76
AIDS pessimistic	0.00	30.27	30.27	0.00	252.23	252.23	0.00	504.47	504.47
Total direct expenditure on HIV/AIDS (million UAH)									
No AIDS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIDS Optimistic	0.41	87.16	87.16	2.03	490.91	490.91	2.03	628.79	628.79
AIDS Pessimistic	0.72	40.65	40.65	3.60	304.13	304.13	3.60	556.37	556.37

[1] Data supplied by WHO Kiev Office, based on the Clinton Foundation best negotiated price for generics. Exchange rate 1US$ = 5.3 UAH.

Source: Authors' calculations.

ANNEX 6 Measuring the Burden of HIV/AIDS in Ukraine: Methodology

Hartunian, Smart, and Thompson (1981) distinguish between two major methods of measuring cost-of-illness: prevalence based and incidence based.

The *prevalence approach* to measuring economic costs of a disease in a period of time (usually a year) is based on 1) identifying all health care costs and productivity losses accruing to the sick during the year (the stock of people with the condition, or prevalence), and 2) calculating expected future income lost by those who die from the disease in this year.

The *incidence approach* focuses only on the new cases of the disorder diagnosed over a certain period (a year), i.e., on the incidence of the disease. The present value of total lifetime health care expenditure, morbidity, and mortality costs are then calculated, based on assumptions about the survival probabilities and an appropriate discount factor.

The drawback of the latter approach to estimating economic burden of disease is the uncertainty associated with the future treatment paths: a significant medical technology breakthrough would require ex-post re-estimation of the future health care costs and survival probabilities. The prevalence approach involves projected future earnings that are also uncertain. In both approaches sensitivity analysis is needed to assess various scenarios within the bounds of realization of stochastic variables. Neither the prevalence or incidence approach is a dominate methodology.

The prevalence approach is usually used to control health care costs and loss of productivity within a year. It uses retrospective dynamics of the disease and current cost estimates, so it is not suitable for evaluation of prevention programs or programs aimed at slowing down illness progression. It is even less useful for conditions whose prevalence changes significantly with time (e.g., cardiovascular disease). The incidence approach allows estimation of avoidable costs and hence economic comparison of interventions that alter future disease incidence.

The incidence-based methodology for the economic evaluation of the HIV intervention programs used in this report follows that methodology of the Global Burden of Disease (GBD) study (see Murray, Lopez, and WHO [1994]; Murray and Acharya [1997]; Murray et al. [2000]; and Murray and Lopez [2000] for details).

The burden of a disease, including HIV/AIDS, is measured in Disability Adjusted Life Years (DALYs). The DALY measure combines potential years lost to premature mortality (Years of Life Lost, or YLL), and the loss of healthy life due to a nonfatal condition/disability (Years Lost to Disability, or YLD): DALY = YLL + YLD.

To calculate the loss of healthy life years, YLD, the incidence of the disease is multiplied by the average duration of each stage of the disease and by a disability (severity) weight for this stage. The year of perfect health has a disability weight of zero; disability weight of one represents an equivalent of death. In calculating DALYs for the GBD, a standard life table is used for all countries. In studies such as Mathers, Vos, and Stephenson (1999) and DHS (1999), national or state life tables (cohort life expectancies) are used to calculate YLL. The GBD uses a 3 percent time discount rate to calculate discounted DALYs. It also applies non-uniform age

Table A6-1. Duration of HIV/AIDS Stages and Disability Weights for YLD Calculation

	Duration				Disability weight			
	Asymptomatic HIV	*HIV-disease*	*AIDS*	*AIDS terminal*	*Asymptomatic HIV*	*HIV-disease*	*AIDS*	*AIDS terminal*
Age group	*0-4 years*	*5-9 years*	*10-14 years*	*15-15.5 years*				
0-4	3	3	1	0.3	0.20	0.31	0.56	0.93
5-14	4	4	4	0.4	0.20	0.31	0.56	0.93
15-24	4	4	4	0.4	0.20	0.31	0.56	0.93
25-34	4	4	4	0.4	0.20	0.31	0.56	0.93
35-44	4	4	4	0.4	0.20	0.31	0.56	0.93
45-54	4	4	4	0.4	0.20	0.31	0.56	0.93
55-64	4	4	4	0.4	0.20	0.31	0.56	0.93
65-74	4	4	4	0.4	0.20	0.31	0.56	0.93
75+	4	4	4	0.4	0.20	0.31	0.56	0.93

Source: Adapted from DHS (1999) and Stouthard et al. (1997).

weights that give more value to young and mid-adult years while discounting very young and older ages. The studies mentioned chose to avoid non-uniform age weights for discounting purposes, the approach undertaken in this study, too.

The severity weights for HIV/AIDS are from the Dutch study (Stouthard et al. 1997) under the assumption that these are the best available weights in the Ukrainian context. Duration of the stages has been adjusted to match Ukrainian epidemiological evidence. The burden of HIV/AIDS in Ukraine is estimated using ten-year age groups.

Table A6-2. Calculation of the Years of Life Lost to Premature Mortality, YLLs Undiscounted and Discounted at 3 Percent

YLL_9 (0,0)			YLL_9 (3,0)		
	Male	*Female*		*Male*	*Female*
0-4	60.56	70.70	*0-4*	27.92	29.34
5-14	54.34	64.43	*5-14*	26.79	28.50
15-24	44.81	54.69	*15-24*	24.62	26.85
25-34	35.95	45.10	*25-34*	21.97	24.70
35-44	27.70	35.70	*35-44*	18.79	21.89
45-54	20.40	26.74	*45-54*	15.23	18.36
55-64	14.24	18.50	*55-64*	11.57	14.16
65-74	9.18	11.26	*65-74*	8.01	9.53
75+	4.65	5.38	*75+*	4.32	4.95

Source: Authors' calculations.

Table A6-3. Summary of DALY Analysis, Optimistic versus Pessimistic Scenario, 2004–14

A. ARV low, hospitalization low	Optimistic minus pessimistic scenarios										
Summary	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Output	0.00	0.13	-0.26	0.58	0.40	0.93	0.86	0.96	1.39	1.37	1.89
Output - index	0.00	0.04	-0.07	0.17	0.12	0.27	0.25	0.28	0.40	0.40	0.55
Output per capita (Index, 2004)	-0.06	-0.05	-0.19	0.01	-0.07	0.04	-0.05	-0.07	0.01	-0.08	0.79
Growth rate, GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Growth rate, GDP per capita	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Capital stock	0.00	0.00	0.03	-0.03	0.10	0.19	0.40	0.58	0.77	1.06	1.32
Capital stock - index	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.06	0.07	0.10	0.13
Effective labor supply	-0.02	-0.01	-0.04	0.03	0.01	0.06	0.05	0.05	0.08	0.08	0.11
Effective labor supply - index	-0.08	-0.03	-0.18	0.15	0.07	0.27	0.23	0.26	0.41	0.39	0.56
Investment	0.00	0.03	-0.06	0.14	0.09	0.22	0.20	0.22	0.32	0.32	0.44
Investment - index	0.00	0.04	-0.07	0.16	0.11	0.26	0.24	0.27	0.39	0.39	0.54
Cumulative HIV+ averted ('000)	43.38	84.16	108.09	118.21	134.12	149.33	178.52	222.17	263.83	304.91	341.92
Additional expenditure on ARV, mil UAH	-0.32	-1.28	1.83	6.08	12.00	19.28	27.38	36.06	44.76	52.94	60.23
Savings in AIDS care, mil UAH	0.00	0.35	1.02	1.88	2.82	3.82	5.03	6.54	8.44	10.79	13.72
Total additional expenditure on HIV/AIDS, mil UAH	-0.32	-1.63	0.81	4.20	9.18	15.46	22.35	29.52	36.32	42.15	46.51
DALYs (0,0) averted ('000)	1,957.12	1,937.21	1,321.86	865.52	1,201.13	1,273.39	1,943.91	2,648.71	2,663.05	2,717.33	2,626.42
DALYs (3,0) averted ('000)	1,328.82	1,269.62	863.32	568.78	785.83	830.38	1,260.80	1,705.52	1,719.49	1,763.12	1,712.05
DALYs (3,0) discounted averted ('000)	623.01	569.85	389.74	257.81	356.37	376.67	573.66	780.07	784.56	799.95	774.02
Cost of ARV per DALY (0,0), UAH	-0.16	-0.66	1.38	7.02	9.99	15.14	14.08	13.61	16.81	19.48	22.93
Cost of ARV per DALY (3,0), UAH	-0.24	-1.00	2.12	10.68	15.27	23.21	21.71	21.14	26.03	30.02	35.18
Cost of ARV per DALY (3,0) discounted, UAH	-0.51	-2.24	4.70	23.56	33.67	51.17	47.72	46.23	57.05	66.17	77.81
Total add_exp per DALY(0,0), UAH	-0.16	-0.84	0.61	4.85	7.64	12.14	11.49	11.15	13.64	15.51	17.71
Total add_exp per DALY(3,0), UAH	-0.24	-1.28	0.94	7.38	11.68	18.61	17.72	17.31	21.12	23.90	27.16
Total add_exp per DALY(3,0) disc, UAH	-0.51	-2.85	2.08	16.27	25.76	41.03	38.95	37.84	46.29	52.68	60.08

(continued on page 83)

Table A6-3. Summary of DALY Analysis, Optimistic versus Pessimistic Scenario, 2004–14 (continued from page 82)

New HIV cases averted, '000	52.03	51.27	34.79	23.27	31.96	33.56	50.38	67.09	67.86	70.20	68.77
Cost of ARV per avert infec, UAH	-6.05	-24.87	52.60	261.10	375.52	574.40	543.39	537.49	659.61	754.05	875.75
Total add_exp per avert infec, UAH	-6.05	-31.69	23.28	180.30	287.27	460.56	443.55	440.01	535.24	600.35	676.24
Additional taxes collected, mil UAH	0.00	32.88	-67.45	150.10	103.76	240.67	222.83	248.91	360.54	355.82	492.52
Net budgetary position	0.32	34.51	-68.26	145.90	94.58	225.22	200.49	219.39	324.22	313.68	446.02
B. ARV high, hospitalization low	**Optimistic minus pessimistic scenarios**										
Summary	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***
Output	0.00	0.13	-0.26	0.58	0.40	0.93	0.86	0.96	1.38	1.37	1.89
Output - index	0.00	0.04	-0.07	0.17	0.12	0.27	0.25	0.28	0.40	0.39	0.55
Output per capita (Index, 2004)	-0.06	-0.05	-0.19	0.01	-0.07	0.04	-0.05	-0.07	0.01	-0.08	0.01
Growth rate, GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Growth rate, GDP per capita	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital stock	0.00	0.00	0.03	-0.03	0.10	0.19	0.39	0.57	0.75	1.03	1.28
Capital stock - index	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.05	0.07	0.10	0.12
Effective labor supply	-0.02	-0.01	-0.04	0.03	0.01	0.06	0.05	0.05	0.08	0.08	0.11
Effective labor supply - index	-0.08	-0.03	-0.18	0.15	0.07	0.27	0.23	0.26	0.41	0.39	0.56
Investment	0.00	0.03	-0.06	0.13	0.09	0.21	0.19	0.21	0.31	0.31	0.43
Investment - index	0.00	0.04	-0.07	0.16	0.11	0.26	0.24	0.26	0.38	0.37	0.52
Cumulative HIV+ averted ('000)	43.38	84.16	108.09	118.21	134.12	149.33	178.52	222.17	263.83	304.91	341.92
Additional expenditure on ARV, mil UAH	-1.58	-6.38	9.15	30.38	60.00	96.38	136.88	180.30	223.80	264.68	301.13
Savings in AIDS care, mil	0.00	1.73	7.33	14.51	22.37	30.92	41.02	53.85	69.80	89.63	114.35
Total additional expenditure on HIV/AIDS	-1.58	-8.11	1.82	15.87	37.63	65.46	95.86	126.45	154.00	175.05	186.78
DALYs (0,0) averted ('000)	1,957.12	1,937.21	1,321.86	865.52	1,201.13	1,273.39	1,943.91	2,648.71	2,663.05	2,717.33	2,626.42
DALYs (3,0) averted ('000)	1,328.82	1,269.62	863.32	568.78	785.83	830.38	1,260.80	1,705.52	1,719.49	1,763.12	1,712.05
DALYs (3,0) discounted averted ('000)	623.01	569.85	389.74	257.81	356.37	376.67	573.66	780.07	784.56	799.95	774.02
Cost of ARV per DALY (0,0), UAH	-0.80	-3.29	6.92	35.09	49.95	75.68	70.41	68.07	84.04	97.40	114.65
Cost of ARV per DALY (3,0), UAH	-1.19	-5.02	10.60	53.40	76.35	116.06	108.56	105.72	130.16	150.12	175.89

(continued on page 84)

Table A6-3. Summary of DALY Analysis, Optimistic versus Pessimistic Scenario, 2004–14 (continued from page 83)

Cost of ARV per DALY (3,0) discounted, UAH	-2.53	-11.19	23.48	117.82	168.36	255.86	238.60	231.13	285.25	330.87	389.04
Total add_exp per DALY(0,0), UAH	-0.80	-4.18	1.38	18.33	31.33	51.40	49.31	47.74	57.83	64.42	71.11
Total add_exp per DALY(3,0), UAH	-1.19	-6.38	2.11	27.89	47.89	78.83	76.03	74.14	89.56	99.28	109.09
Total add_exp per DALY(3,0) disc, *UAH*	-2.53	-14.22	4.67	61.54	105.59	173.77	167.09	162.10	196.29	218.82	241.31
New HIV cases averted, '000	52.03	51.27	34.79	23.27	31.96	33.56	50.38	67.09	67.86	70.20	68.77
Cost of ARV per avert infec, UAH	-30.27	-122.53	178.45	873.00	2,578.76	3,015.87	4,078.88	3,578.94	3,335.82	3,900.42	4,289.47
Total add_exp per avert infec, UAH	-30.27	-155.78	35.50	455.97	1,617.31	2,048.29	2,856.48	2,510.02	2,295.42	2,579.58	2,660.57
Additional taxes collected, mil UAH	0.00	32.88	-67.43	150.11	103.75	240.61	222.68	248.63	360.09	355.18	491.67
Net budgetary position	1.58	40.99	-69.25	134.25	66.12	175.15	126.82	122.18	206.09	180.14	304.90
C. ARV high, hospitalization high	**Optimistic minus pessimistic scenarios**										
Summary	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***
Output	0.00	0.13	-0.26	0.58	0.40	0.93	0.86	0.96	1.39	1.37	1.89
Output - index	0.00	0.04	-0.07	0.17	0.12	0.27	0.25	0.28	0.40	0.40	0.55
Output per capita (Index, 2004)	-0.06	-0.05	-0.19	0.01	-0.07	0.04	-0.05	-0.07	0.01	-0.08	0.01
Growth rate, GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Growth rate, GDP per capita	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital stock	0.00	0.00	0.03	-0.03	0.11	0.19	0.40	0.57	0.76	1.05	1.31
Capital stock - index	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.06	0.07	0.10	0.13
Effective labor supply	-0.02	-0.01	-0.04	0.03	0.01	0.06	0.05	0.05	0.08	0.08	0.11
Effective labor supply - index	-0.08	-0.03	-0.18	0.15	0.07	0.27	0.23	0.26	0.41	0.39	0.56
Investment	0.00	0.03	-0.06	0.14	0.09	0.21	0.20	0.22	0.32	0.31	0.44
Investment - index	0.00	0.04	-0.07	0.16	0.11	0.26	0.24	0.27	0.39	0.38	0.53
Cumulative HIV+ averted ('000)	43.38	84.16	108.09	118.21	134.12	149.33	178.52	222.17	263.83	304.91	341.92
Additional expenditure on ARV, mil	-1.58	-6.38	9.15	30.38	60.00	96.38	136.88	180.30	223.80	264.68	301.13
Savings in AIDS care, mil	0.00	1.73	12.88	27.24	43.09	60.37	80.78	106.64	138.81	178.81	228.71
Total additional expenditure on HIV/AIDS	-1.58	-8.11	-3.73	3.14	16.91	36.01	56.10	73.66	84.99	85.87	72.42
DALYs (0,0) averted ('000)	1,957.12	1,937.21	1,321.86	865.52	1,201.13	1,273.39	1,943.91	2,648.71	2,663.05	2,717.33	2,626.42

(continued on page 85)

Table A6-3. Summary of DALY Analysis, Optimistic versus Pessimistic Scenario, 2004–14 *(continued from page 84)*

Summary	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
DALYs (3,0) averted ('000)	1,328.82	1,269.62	863.32	568.78	785.83	830.38	1,260.80	1,705.52	1,719.49	1,763.12	1,712.05
DALYs (3,0) discounted averted ('000)	623.01	569.85	389.74	257.81	356.37	376.67	573.66	780.07	784.56	799.95	774.02
Cost of ARV per DALY (0,0), UAH	-0.80	-3.29	6.92	35.09	49.95	75.68	70.41	68.07	84.04	97.40	114.65
Cost of ARV per DALY (3,0), UAH	-1.19	-5.02	10.60	53.40	76.35	116.06	108.56	105.72	130.16	150.12	175.89
Cost of ARV per DALY (3,0) discounted, UAH	-2.53	-11.19	23.48	117.82	168.36	255.86	238.60	231.13	285.25	330.87	389.04
Total add_exp per DALY(0,0), UAH	-0.80	-4.18	-2.82	3.62	14.08	28.27	28.86	27.81	31.91	31.60	27.57
Total add_exp per DALY(3,0), UAH	-1.19	-6.38	-4.32	5.51	21.52	43.36	44.49	43.19	49.43	48.70	42.30
Total add_exp per DALY(3,0) disc, UAH	-2.53	-14.22	-9.57	12.16	47.45	95.59	97.78	94.43	108.33	107.34	93.56
New HIV cases averted, '000	52.03	51.27	34.79	23.27	31.96	33.56	50.38	67.09	67.86	70.20	68.77
Cost of ARV per avert infec, UAH	-30.27	-122.53	178.45	873.00	2,578.76	3,015.87	4,078.88	3,578.94	3,335.82	3,900.42	4,289.47
Total add_exp per avert infec, UAH	-30.27	-155.78	-72.75	90.10	726.78	1,126.71	1,671.63	1,462.15	1,266.81	1,265.36	1,031.54
Additional taxes collected, mil UAH	0.00	32.88	-67.43	150.12	103.78	240.68	222.80	248.82	360.37	355.57	492.20
Net budgetary position	1.58	40.99	-63.70	146.99	86.87	204.67	166.71	175.16	275.38	269.70	419.78

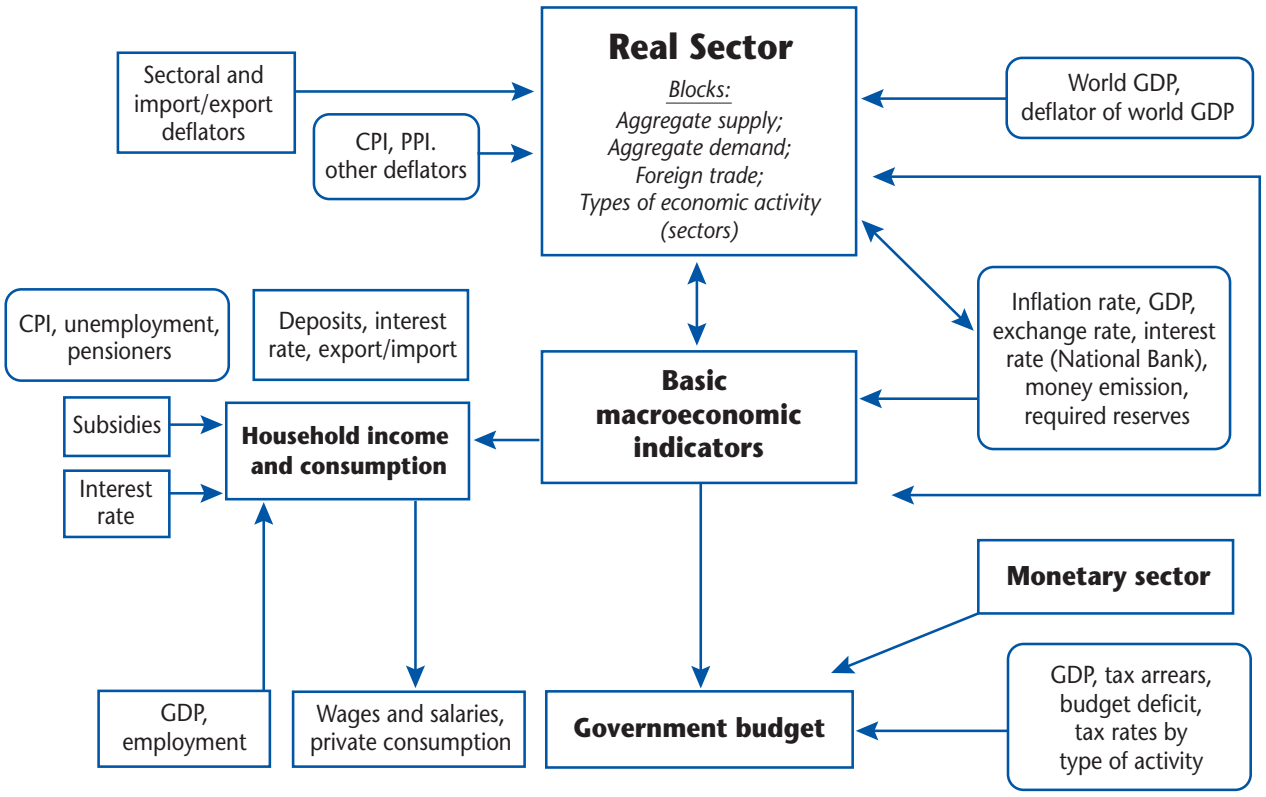
Source: Authors' calculations.

ANNEX 7 Macroeconometric Model: Methodology, Assumptions, and Estimation

The model is based on a system of equations linking sectors (types) of economic activity in Ukraine. It includes aggregate national output (real sector), consumption, investments, employment, foreign trade, government budget, and monetary sector. The reduced form model is econometrically estimated. Using economic policy variables as controls, we solve the model for endogenous variables such as private and public consumption, gross investment, tax rates, export and import of goods and services, using the projected values of exogenous variables such as interest rate, exchange rate, inflation, and sectoral deflators. Assumptions of balanced budget and accounting identities close the model. The block diagram representing theoretical structure of the model and linkages between its components is in Figure A7-1.

Real sector model links though the accounting identities estimated GDP measures. The model has four blocks. The *aggregate supply block* forms the production function (the sum of domestic production

Figure A7-1. Macroeconometric Model for Ukraine: Sectoral Structure



Source: Institute for Economic Forecasting.

and imports) as a function of gross capital formation, employment, and import of goods and services for final consumption. Estimated equations include time-lagged variables. Employment and investment equations are estimated within this block.

The block of *aggregate demand* represents the expenditure measure of GDP and includes final consumption, government expenditure, gross fixed capital formation, changes in inventories, and export of goods and services.

The *foreign trade* block defines export, import, and trade balance for goods and services in constant and current prices. The export supply function depends on domestic and world GDP and relative prices. Import demand function depends on real domestic GDP, exchange rate, and terms of trade.

The *disaggregation* block breaks down aggregate GDP into sectoral components using the production approach. Sectors explicitly modelled are agriculture, hunting, forestry, and fishing; mining; manufacturing; energy, gas and water industry; construction; wholesale and retail trade and repair services; transport and telecommunications; education; health care and social services; etc. Sectoral models represent an econometric estimation of two-factor production functions (sectoral capital and labor), with or without time trend, fitted to the 1994-2004 data.

The ***household income and consumption*** model defines the disposable income, labor productivity, and unemployment levels. Average monthly real wages, pensions, and saving are evaluated in this block. Saving is a function of disposable income, interest rate, and time trend.

The model of ***government budget*** describes budget revenue, expenditure, and balance. Budget revenue is a sum of taxes applied to the corresponding tax base plus other administrative levies. Based on the current budget structure, the model includes the following tax components: corporate profit tax; value added tax (VAT); excise duty; personal income tax; land tax; deductions for geological survey and exploration; stamp duty; proceeds from privatization of state property, etc. These components represent more than 80 percent of the budget revenue and are included in the model as endogenous variables.

The model of ***monetary sector*** is based on the equilibrium assumption (money supply equals money demand). Output variables include the projected money aggregate M2 and base money, given GDP and inflation rate. The model allows incorporation of monetary policy instruments such as money emission, interest rate, and velocity of money.

Sectoral macroeconometric models are implemented using the E-Views-3 econometric modelling package. Simulations were run based on the estimated model coefficients, projected values of exogenous variables, and a range of scenarios with respect to controls. Direct relations and feedbacks between the sectoral models allow us to study direct and indirect impact of change in exogenous variables/controls on endogenous variables in the model. Linkages between the sectors are presented in Figure A7-1. For example, changes in GDP in constant prices and interest rates generated in Real and Monetary blocks enter the Household income and consumption. There is a feedback from the government budget sector through total budget revenue and a resulting disposable income that enters the household's saving and consumption functions. Control variables in the Monetary sector are tax rates and the taxation base. Changes in total budget revenues feed into the Household income and consumption block, while changes in government deficit feed into the Monetary block. As a feedback, real sector supplies the GDP in current prices to the government budget block. Other endogenous variables used in the Monetary block are unemployment rate, budget deficit, GDP in current prices, and exchange rate. Estimated macroeconometric model based on 1986-2003 data is presented in Appendix A7 on page 92.

Model Assumptions

Modelling was undertaken using what we estimate as the most plausible assumptions regarding future economic growth in Ukraine, future invest-

Table A7-1. Projected Macroeconomic Indicators until 2014

Indicators	Years and periods							
	ACTUAL						FORECAST	
	1999	2000	2001	2002	2003	2004	2005-09	2010-14
Annual change in real indicators								
GDP, %	-0.2	5.9	9.2	5.2	9.6	12.1	7.2	5.7
Population, '000,000	49.5	49.0	48.5	47.9	47.5	47.1	46.1	44.8
Aggregate supply								
Fixed assets, %	1.3	1.0	1.1	1.9	2.3	3.5	2.5	2.2
Labor force, '000,000	21.8	21.3	21.02	21.38	21.45	21.46	21.45	21.44
Final consumption, %	-3.7	2.0	9.3	5.0	12.8	13.0	5.5	4.5
private	-1.9	2.5	9.6	6.0	12.4	16.3	6.8	5.4
public	-7.9	1.0	10.4	-0.1	14.8	4.7	1.6	1.7
Gross fixed capital formation, %	0.1	12.4	6.2	5.3	15.8	10.2	11.8	10.8
Investments in fixed capital	0.4	14.4	20.8	8.9	27.6	28.9	12.6	11.8
Foreign trade								
Export of goods and services (US$ '000,000), %	-3.2	14.4	8.0	11.1	24.1	18.1	6.6	5.3
Import of goods and services (US$ '000,000), %	-19.1	18.9	13.0	7.4	34.7	13.6	6.8	5.4
Prices and exchange rate								
CPI, % pa	22.7	28.2	12.0	0.8	5.2	9.1	6.2	5.0
PPI, % pa	31.1	20.9	8.7	3.0	7.7	20.4	7.0	5.1
Exchange rate, average, UAH/US$	4.13	5.44	5.37	5.32	5.33	5.32	5.29	5.25
Money and credit extension								
NBU refinancing rate, % pa	44.0	29.6	20.2	9.2	7.0	9.0	7.0	5.3
Interest rate on loans, % pa	53.6	40.3	31.9	24.8	18.0	16.5	13.0	9.2
Interest rate on deposits, % pa	20.8	13.5	11.2	7.8	6.5	6.3	6.2	6.0
Money base, % pa	39.0	40.0	37.4	33.6	30.1	34.2	25.5	17.2
Money supply (M3), % pa	40.5	46.1	41.9	41.8	46.5	32.1	27.7	18.1
Government budget								
Total revenue, % GDP	25.2	28.9	26.9	27.4	28.5	24.5	24.7	24.9
Total expenditure, % GDP	26.7	28.3	27.2	26.7	28.7	25.4	24.9	25.0
Balance, % GDP	-1.5	0.6	-0.3	0.7	-0.2	-3.2	-2.2	-0.1
Social indicators								
Real monthly wages, %	-8.9	-0.9	19.3	18.2	15.2	8.8	7.7	6.3
Unemployment rate (ILO methodology), %	11.4	11.1	10.9	10.1	9.3	9.4	9.3	9.1

Notes: CPI = Consumer Price Index; PPI = Producer Price Index; NBU = National Bank of Ukraine; M3 = Broad Money Aggregate.

Sources: Derzhkomstat (2004a and b), Ministry of Economy and European Integration (2004), NBU (2004), and Institute for Economic Forecasting of the National Academy of Sciences of Ukraine.

ment activity, and increased international competitiveness of the Ukrainian economy. The following assumptions about the external and internal factors were made:

External factors: Global future economic development (average per annum over 2005-14): growth rates of the world GDP 2.5-3.1 percent; EU GDP 1.6-2.3 percent; Russian Federation GDP 4.5-5.6 percent; world GDP deflator 2.0-2.4 percent; global crude oil prices US$ 38-42 per barrel; world trade growth 6.1-8.0 percent.

Internal factors: Annual average inflation rates in 2005-06 increase to 14-10 percent, returning to 5.0-4.5 percent over 2007-14; factor increase in price of natural monopolies products/services (2014 compared 2004): electricity 1.6, natural gas 1.8, railroad cargo transportation 1.4; slower real appreciation of UAH (based on the expected USA inflation) by 1.0-1.1 percent per annum over 2004-14; reduction in the nominal interest rate on loans from 18.5 percent in 2005 to 9.5 percent in 2014; a corresponding reduction in an average interest rate on deposits from 6.5 percent to 6.0 percent; gradual increase in wages as share of GDP to 46.2-46.5 percent; reduction in budget deficit from 3.2 percent in 2005 to the balanced budget in 2014; net foreign direct investments of at least US$ 1.5-2.0 billion per annum over 2004-14.

These are the underlying model assumptions of the baseline macroeconomic scenario of the Ukrainian economy for 2005-14, without the HIV/AIDS effects (Table A7-1).

The baseline scenario is based on the following assumptions: high average annual rates of economic growth (through innovation/technical change); increase in real household incomes; increase in investments in fixed capital at a rate faster than GDP growth; growth in net exports; moderate government spending; labor productivity growth; decrease in the gap between real wages and labor productivity growth rates; decline in the share of imports in total consumption despite the real exchange rate appreciation; anticipatory growth of investments versus GDP dynamics; and increased share of debt and FDIs in total investment. The baseline scenario assumes successful implementation of the macroeconomic program, focussing on improved efficiency of enterprises, their restructuring and modernization, banking system and financial stability, and a favorable business climate attracting foreign and expatriated domestic capital.

The estimated macroeconometric model was applied, using the labor force projections discussed in Chapter 4, under the three epidemic scenarios. Changes in employment impact aggregate supply, GDP, sectoral value-added, labor productivity, and through these indicators, other variables, such as import of goods and services, household savings, budget balance, etc. Macroeconomic costs of the HIV/AIDS epidemic are quantified as the difference between the projected endogenous variables in three epidemic scenarios compared to the baseline (no-AIDS) scenario.

Table A7-2. Macroeconometric Model: Estimated Percentage Difference in Selected Macroeconomic Indicators in Three Epidemic Scenarios, 2004-14

	Variable	2005	2014	2005	2014	2005	2014
AIDS scenario		*Optimistic*		*Medium*		*Pessimistic*	
GDP (production)	GDP96	-0.44	-1.57	-0.39	-2.48	-0.40	-3.01
GDP (expenditure)	GDP96_SUM	-0.41	-1.43	-0.37	-2.25	-0.37	-2.74
Investments	I96	-0.43	-1.46	-0.39	-2.28	-0.39	-2.78
Imports	M96	0.06	0.17	0.05	0.28	0.05	0.34
GDP per employee	P96	-0.12	-0.51	-0.11	-0.80	-0.11	-0.99
Savings	S96f	-0.02	-0.06	-0.02	-0.09	-0.02	-0.11
Budget revenue	REV	-0.39	-1.34	-0.36	-2.11	-0.36	-2.57

Source: Authors' calculations.

Note: All variables are in 1996 constant prices. Percentage difference relates to the difference with the underlying "no-AIDS" demographic scenario.

Table A7-3. Rating of Oblasts (Major Agricultural Producers) with Respect to HIV Prevalence, 2004

Per thousand

Oblast	HIV prevalence group	Employment*	Unemployment*	Labor force
AR of Crimea	5	1,108.0	79.3	1,187.3
Vinnitsa	2	826.7	49.2	875.9
Volyn	3	445.6	61.4	507.0
Dnipropetrovsk	5	1,645.4	130.9	1,776.3
Donetsk	5	2,129.0	183.9	2,312.9
Zhytomyr	2	509.2	74.9	584.1
Kyiv	4	739.6	81.5	821.1
Kirovograd	3	462.1	51.4	513.5
Lviv	2	1,110.4	130.0	1,240.4
Odesa	5	1,065.2	60.3	1,125.5
Poltava	2	677.4	61.6	739.0
Sumy	1	564.3	76.0	640.3
Ternopil	1	374.5	56.1	430.6
Kharkiv	3	1,308.8	139.2	1,448.0
Khmelnytsky	3	543.5	83.3	626.8
Cherkasy	4	549.9	69.2	619.1
Chernigiv	4	539.6	61.3	600.9

* *Source:* Derzhkomstat (2004, p. 850).

Weighted average ranking 3.6, Gross agricultural product in selected regions UAH 43 billion, 78 percent of total agricultural production in 2003.

Model Application

Under the employment scenarios (without AIDS and three "with AIDS" scenarios based on medium, optimistic and pessimistic epidemic forecasts) developed in Chapter 4, national labor force is predicted to decline over 2004-14 by 2.3 million (11.6 percent) under the "no-AIDS, underlying demographic scenario, 2.5 million (12.7 percent) under the AIDS optimistic scenario, taking into account epidemiologic data, and 2.7 million (13.6 percent) under the pessimistic scenario. Feeding the labor force projections into the macroeconometric model, we quantify the effects of HIV/AIDS on GDP (in production and expenditure measures), accumulated fixed capital, import of goods and services, labor productivity, household savings, and budget balance. All of these indicators (in constant 1996 prices) decline over 2004-14 below what would have been their benchmark value in the "no-AIDS" scenario (see Table A7-2 on page 89).

Table A7-4. Regional Trends in Average Monthly Nominal Wages, 1999-2003

	1999	2000	2001	2002	2003
National average	100.0	100.0	100.0	100.0	100.0
Crimea	94.4	97.8	96.8	95.1	93.7
Vinnitsa	72.5	69.1	69.1	70.4	72.1
Volyn	66.3	65.1	64.6	67.2	69.0
Dnipropetrovsk	117.4	118.8	119.0	116.4	113.8
Donetsk	123.6	127.1	123.2	120.1	119.0
Zhytomyr	75.3	71.3	70.7	71.2	72.2
Zakarpatska	73.0	74.7	76.5	78.4	81.9
Zaporizhya	120.8	125.8	121.9	118.2	117.1
Ivano-Frankivsk	78.7	81.8	83.3	84.5	86.9
Kyiv	107.3	104.9	101.9	100.4	101.7
Kirovograd	77.0	73.8	74.3	74.9	76.3
Lugansk	103.4	101.0	102.9	104.4	102.4
Lviv	85.4	85.4	87.5	90.1	90.7
Mykolayiv	94.9	98.8	105.1	105.7	101.8
Odesa	102.8	102.5	98.4	100.7	98.3
Poltava	97.2	95.6	93.9	94.1	94.5
Rivne	75.8	75.1	78.8	82.9	84.5
Sumy	84.3	84.1	83.3	81.6	82.1
Ternopil	62.9	58.6	61.1	63.0	65.8
Kharkiv	103.4	100.0	99.7	98.3	98.3
Kherson	80.3	75.1	74.9	76.8	76.9
Khmelnytsky	71.3	67.7	67.8	68.5	69.8
Cherkasy	82.0	76.1	73.6	73.3	75.8
Chernivtsi	69.1	68.2	70.1	72.0	74.4
Chernigiv	79.2	76.7	75.6	73.6	74.0
The city of Kyiv	170.2	176.0	176.5	170.8	164.6
The city of Sevastopol	105.1	109.0	104.5	101.2	105.2

Source: State Statistics Committee of Ukraine.

APPENDIX A7. ESTIMATED MACROECONOMETRIC MODEL

Coefficients are estimated using 1986-2003 data

REAL SECTOR MODEL

Aggregate supply block

Total supply, at 1996 prices:

D(LOG(AS96)) = 0.4350·D(LOG(I96)) +0.4215·D(LOG(L)) + 0.3971·D(LOG(M96)) -

	(5.23)	(1.28)	(5.23)
0.1626·F94			
(-3.21)			
R^2 = 0.855	DW = 2.52	S.E. = 0.034	

Total employment:

L = 4.5516 + 9.25e-06·GDP96 + 0.7462·L(-1)

(1.51)	(1.59)	(4.86)	
R^2 = 0.905	DW = 2.14	S.E. = 0.587	

Fixed assets, at 1996 prices:

K96=K96(1)+DK96

Growth of fixed assets, at 1996 prices:

DK96=I96 (1-0.6)

Gross domestic product (supply), at 1996 prices:

1GDP96 = AS96 - M96

Aggregate demand block

Total consumption, at 1996 prices:

C96 = CG96 + CP96.

Government consumption, at 1996 prices

CG96 = 0.1964·GDP96 +612.8428·F92 - 200.4952

	(21.66)	(1.33)	(-0.16)
R^2 = 0.968	DW = 1.79	S.E. = 176	2.59

Private consumption, at 1996 prices:

CP96 = 10194.982 + 0.4795· GDP96 + 1.2969·(RDN-INFCPI)

(5.41)	(34.21)	(2.43)
R^2 = 0.987	DW = 1.77	S.E. = 2692.36

Gross investments, at 1996 prices:

I96 = 0.228·GDP96 - 1.0957·(RKN-INFPPI) + 0.0312·K96(-1) -17713.3034

(14.47)	(-3.16)	(2.15)	(-1.99)
R2 = 0.981	DW = 1.46	S.E. = 1444.747	

Gross domestic product (demand), at 1996 prices:

2GDP96 = C96 + I96 + INV96 + X96 - M96.

Gross domestic product, at the prices of current period:

GDP = C + I + INV + X - M.

Total consumption, at the prices of current period:

C = CG + CP.

Government consumption, at the prices of current period:

CG = CG96·DEFCG.

Private consumption, at the prices of current period:

CP = CP96·DEFCP.

Gross investments at the prices of current period:

I = I96·DEFI.

Change in current assets stock [inventory], at the prices of current period:

INV = INV96·DEFINV.

GDP (supply), at the prices of current period:

1GDP = GDP96 · DEFGD.

GDP (demand), at the prices of current period:

2GDP = CP1 + CG + I + INV + X - M.

Foreign trade block

Export of goods and services, at 1996 prices:

X96 = 3.0627·WGNP96 + 73.6083· (EO·(US_DEFGDP/DEFX)) - 44274.9266

(5.93)	(1.15)	(-3.03)
R^2 = 0.851	DW = 2.15	S.E. = 2847.32

Import of goods and services, at 1996 prices

M96 = -0.0555·GDP96 - 355.6163·(EO·(DEFM/DEFGDP)) +1385.1064·TREND+25684.5864

(-1.11)	(-1.24)	(1.48)	2.18
R^2 = 0.769	DW = 2.68	S.E. = 3308.206	

Export of goods and services, at the prices of current period:

X = X96·DEFX.

Import of goods and services, at the prices of current period:

M = M96·DEFM.

Trade balance, at 1996 prices:

TB96 = X96 - M96.

Trade balance, at the prices of current period:

TB = X - M.

Export of goods and services at current prices, USD:

X$ = X96·PX$.

Import of goods and services at current prices, USD:

M$ = M96·PM$.

Trade balance at current prices, USD:

TB$ = X$ - M$.

LIST OF VARIABLES

Endogenous variables

L - total employment, mil;

GDP - GDP at current prices;

GDP96 - GDP at 1996 prices;

CO - total consumption, at current prices;

CO96 - total consumption, at 1996 prices;

CP - private consumption, at the prices of current period;

CP96 - private consumption, at 1996 prices;

CG - state consumption, at the prices of current period;

CG96 - state consumption, at 1996 prices;

DK96 - growth of fixed assets, at 1996 prices;

I - gross investments, at the prices of current period;

I96 - gross investments, at 1996 prices;

REV - gross budget receipts;

INV - change in current assets stock, at the prices of current period;

INV96 - change in current assets stock, at 1996 prices;

K96 - fixed assets, at 1996 prices;

M - import, at the prices of current period;

M96 - import, at 1996 prices;

M$ - import, USD;

AS96 - total supply, at 1996 prices;

X - export, at the prices of current period;

X96 - export, at 1996 prices;

X$ - export, USD;

Exogenous variables

WGNP96 - global GDP at 1996 prices, USD;

INFCPI - growth of consumer price index;

INF_PI - growth of producer price index;

DEFGDP - GDP deflator, 1996 = 1;

US_DEFGDP - global GDP deflator, 1996 = 1;

DEFCP - private consumption deflator, 1996 = 1;

DEFCG - state consumption deflator, 1996 = 1;

DEFI - gross investments deflator, 1996 = 1;

DEFINV - deflator of change in current assets stock, 1996 = 1;

DEFM - import deflator, 1996 = 1;

PM$ - import price index, USD;

DEFX - export deflator, 1996 = 1;

PX$ - export price index, USD;

DD - total amount of deposits;

RDN - deposit interest rate;

RKN - credit interest rate;

EO - exchange rate, UAH for USD 1;

TREND - time factor;

F92, *F93*, *F94*, *F95* - dummy variables (to allow for the structural change in 1992-1995).

DISAGGREGATE VARIABLES BLOCK

(models of appraisal of gross value added (GVA) as per the kinds of economic activity).

Economic and mathematical models in macrosectors have been constructed as the models of forecasting the GDP in terms of production functions applying relevant behavior regression equations relating to the assessment of employment and fixed assets as per the basic kinds of economic activity (time horizons: 1994-2004).

Model specification has been elaborated pursuant to the following: the first two letters show the name of economic indicator (VA - gross value added, EM - employment, K - fixed assets, DK - net annual growth of basic assets); the next three-four letters indicate relevant kind of economic activity; the remaining symbols are the prices for economic indicators. All indicators in the models of relevant blocks are calculated at basic prices of 1996, so the identifiers of relevant variables, excluding the number of employed persons in macrosectors, end in figures 96.

Specification of block of the models intended for assessment of gross value added (GVA) as per the kinds of economic activity

1. Economy as a whole:

VA_ALL96 = 0.3710*K1_ALL96 + 8201.0788*EM_ALL - 430735.2378

	(10,18)	(3,62)	(-5,41)	
R^2 = 0,949	DW = 1,73	S.E. = 4271,36		

EM_ALL = -1.0306e-05*VA_ALL96 + 3.2402e-05*K1_ALL96 .8345 - 0.7893*TREND

	(-0,69)	(3,38)	(-0,13)	(-7,08)
R^2 = 0,982	DW = 2,61	S.E. = 0,1485		

K1_ALL96 = K_ALL96(-1) + DK_ALL96

2. Agriculture, hunting, forestry and fishing industry:

VA_AGR96 = 0.0392*K1_AGR96 + 3341.6137*EM_AGR - 12203.0545 + 200.9895*LOG(TREND)

	(0,57)	(2,10)	(-1,03)	(0,38)
R^2 = 0,450	DW = 1,66	S.E. = 765,795		

EM_AGR = 0.000134*VA_AGR96 - 4.3735e-06*K1_AGR96 + 4.3738 - 0.0133*TREND

(2,23)	(-0,34)	(2,83)	(-0,76)
R2 = 0,470	DW = 2,05	S.E. = 0,1474	

K1_AGR96 = K_AGR96(-1) + DK_AGR96

3. Mining industry:

VA_INI96 = 0.1401*K1_INI96 + 1068.8495*EM_INI - 4183.2123

	(11,01)	(1,87)	(-4,08)
R^2 = 0,959	DW = 1,78	S.E. = 134,0027	

EM_INI = 2.3338e-05*VA_INI96 + 3.7847e-05*K1_INI96 - 0.7579 - 0.08499*TREND

(0,4864)	(3,8371)	(-2,4373)	(-10,7983)
R^2 =0,980	DW = 2,70	S.E. = 0,0173	

K1_INI96 = K_INI96(-1) + DK_INI96

4. Manufacturing industry

VA_INA96 = 0.3858*K1_INA96 + 3542.3093*EM_INA - 53568.8255

	(12,24)	(2,97)	(-6,97)
R^2 = 0,961	DW = 1,84	S.E. =952,2076	

EM_INA = -7.4318e-07*VA_INA96 + 5.383e-05*K1_INA96 - 3.5575 - 0.2949*TREND

	(-0,5735)	(3,5278)	(-1,8336)	(-4,6155)
R^2 =0,862	DW = 2,40	S.E. = 0,1482		

K1_INA96 = K_INA96(-1) + DK_INA96

5. Production and distribution of electric power, gas and water:

VA_INE96 = 0.1763*K1_INE96 + 2268.3435*EM_INE - 7939.2236

	(6,39)	(2,65)	(-3,06)	
R^2 = 0,889	DW = 2,39	S.E. =194,5263		

LOG(EM_INE) = 0.6253*LOG(VA_INE96) + 59556.3731*(1/(K1_INE96)) - 6.0995 - 0.0288*TREND

	(1,26)	(0,66)	(-1,10)	(-1,58)
R^2 =0,860	DW = 1,83	S.E. = 0,050		

K1_INE96 = K_INE96(-1) + DK_INE96

6. Construction:

VA_CON96 = 0.2546*K1_CON96 + 4810.7954*EM_CON - 5026.1759

	(1,35)	(4,32)	(-1,51)
R^2 = 0,732	DW = 2,03	S.E. =590,3322	

EM_CON = 7.6729e-05*VA_CON96 + 0.00013*K1_CON96 - 0.8327 - 0.0651*TREND

	(1,19)	(0,97)	(-0,52)(-1,35)
R^2 =0,7963	DW = 1,25	S.E. = 0,099	

K1_CON96 = K_CON96(-1) + DK_CON96

7. Wholesale and retail trade, trade in transport facilities, repair services:

VA_TR96 = 0.5133*K1_TR96 + 1575.18601*EM_TR - 5900.9751 + 141.2162*TREND

	(2,11)	(0,62)	(-2,39)	(0,52)
R^2 =0,9303	DW = 1,70	S.E. =934,4289		

EM_TR = 3.8287e-05*VA_TR96 + 2.8623e-05*K1_TR96 + 0.8123 - 0.0026*TREND

	(0,62)	(0,59)	(1,10)	(-0,59)
R^2 =0,7660	DW = 2,51	S.E. =0,1456		

K1_TR96 = K_TR96(-1) + DK_TR96

8. Transport and communications:

LOG(VA_TCO96) = 0.6540*LOG(K1_TCO96) + 1.0976*LOG(EM_TCO) + 1.3929

	(3,00)	(3,02)	(0,56)
R^2 =0,844	DW = 1,22	S.E. =0,0540	

EM_TCO = 1.1279e-05*VA_TCO96 + 1.4958e-05*K1_TCO96 - 0.0864 - 0.0503*TREND

(0,57)	(1,84)	(-0,16)	(-1,97)
R^2 =0,7736	DW = 2,43	S.E. =0,0445	

K1_TCO96 = K_TCO96(-1) + DK_TCO96

9. Financial activity:

LOG(VA_FIN96) = 0.8387*LOG(K1_FIN96) + 1.1783*EM_FIN + 0,51

	(9,95)	(2,78)	(0,32)
R^2 =0,553	DW = 0,94	S.E. =0,1626	

LOG(EM_FIN) = -0.0866*LOG(VA_FIN96) + 0.03994*LOG(K1_FIN96) - 1.2761 - 0.0053*TREND

	(-0,96)	(0,45)	(-0,76)	(-0,23)
R^2 =0,546	DW = 2,86	S.E. =0,0641		

K1_FIN96 = K_FIN96(-1) + DK_FIN96

10. Operations with real estate, leasing and services to legal entities:

VA_REL96 = 0.16797*K1_REL96 + 1423.2994*EM_REL - 21028.7486

	(4,62)	(0,68)	(-5,49)
R^2 = 0,975	DW = 2,13	S.E. =285,7419	

EM_REL = 2.3452e-05*VA_REL96 + 1.4348e-06*K1_REL96 + 0.2387 + 0.0264*TREND

	(0,91)	(0,75)	(0,20)	(2,34)
R^2 =0,9498	DW = 2,55	S.E. =0,0356		

K1_REL96 = K_REL96(-1) + DK_REL96

11. State management:

LOG(VA_GOV96) = 2.1161*LOG(K1_GOV96) + 0.4685*LOG(EM_GOV) - 11.7199

	(2,28)	(1,08)	(-1,42)
R^2 =0,862	DW = 2,84	S.E. =0,0765	

EM_GOV = 8.1139e-05*VA_GOV96 + 1.9106e-05*K1_GOV96 - 0.1142

	(1,16)		(0,85)	(-0,21)
R^2 =0,783	DW =1,93	S.E. =0,0521		

K1_GOV96 = K_GOV96(-1) + DK_GOV96

12. Education:

VA_EDU96 = 0.0538*K1_EDU96 + 432.0102*EM_EDU - 602.6311

	(0,89)	(1,68)	(-0,15)	
R^2 =0,612	DW =0,71	S.E. =468,8820		

LOG(EM_EDU) = -0.4201*LOG(VA_EDU96) + 0.1215*LOG(K1_EDU96) + 3.4753 - 0.34098*LOG(TREND)

	(-1,05)	(0,71)	((	(0,28)	(-4,25)
R^2 =0,842	DW = 1,56	S.E. =0,0939			

K1_EDU96 = K_EDU96(-1) + DK_EDU96

13. Health care and social aid:

VA_HEC96 = 0.15004*K1_HEC96 + 2575.3893*EM_HEC - 3024.6736

	(2,16)	(1,43)	(-1,23)
R^2 =0,517	DW =0,81	S.E. =257,5275	

EM_HEC = 4.2034e-05*VA_HEC96 + 9.2602e-06*K1_HEC96 + 1.1866 - 0.01852*TREND

	(1,26)	(0,89)	(6,18)	(-4,49)
R^2 =0,853	DW = 2,56	S.E. =0,0245		

K1_HEC96 = K_HEC96(-1) + DK_HEC96

14. Collective, public and personal services, house-maid services, exterritorial activity:

LOG(VA_SER96) = 1.5499*LOG(K1_SER96) - 0.3157*EM_SER - 500.5321

	(1,75)	(-0,77)	(-0,88)
R^2 =0, 0,507	DW =0,72	S.E. =0,1422	

EM_SER = 2.6679e-05*VA_SER96 + 1.4354e-05*K1_SER96 + 0.5839 - 0.0262*TREND

	(0,76)	(0,60)	(1,45)	(-2,33)
R^2 =0,712	DW = 1,23	S.E. =0,0446		

K1_SER96 = K_SER96(-1) + DK_SER96

THE MODEL OF CONSUMPTION SECTOR AND PERSONAL INCOME:

Disposable income:

DI = GDP-REQ.

Real average monthly wages and salaries, at 1996 prices:

@PCH(WG96) = -0.1654·U_REAL - 0.0002·INFCPI + 0.1154·TREND

	(-2.58)	(-3.48)	(2.81)
R^2 = 0.731	DW =2.39	S.E. = 0.2796	

Real average monthly pension, at 1996 prices:

PENS96 = 0.1804·WG96 + 3.2552

(11.26)	(0.54)	
R^2 = 0.894	DW = 0.83	S.E. = 19.1399

Savings, at 1996 prices:

S96 = 0.01638955483·DI96 + 55.67839394·RDR + 1664.713306·TREND - 11008.73595

	(0.45)	(1.56)	(4.41)(-1.50)
R^2 = 0.855DW =1.09	S.E. = 3083.401		

Difference between investments and savings, at 1996 prices:

S96_DIF = (I96 - S96)/S96 ·100

Labor productivity, at 1996 prices:

P96 =GDP96/L/1000

Unemployment level:

LOG(U_REAL) = 0.2301574098·LOG(DEFGDP) + 2.14804849

THE MODEL OF PUBLIC FINANCES SECTOR:

Total budget receipts:

REV = TAX1+TAX2+TAX3+TAX4+TAX5+TAX6+TAX7+ TAX8+TAX09.

Total budget expenditures:

EXPD=REV+SLGDP·GDP.

Budgetary balance:

SALDO=REV-EXPD.

Value added tax:

TAX1+(NTAX1-NTAX1(-1)) = 19538.81354 + 0.06423515397·GDP - 13880.34951·GOV1 -

	(3.492)	(10.883)	(-3.329)

62140.0199·RATE1.

(-3.1345)

R^2 = 0.976	DW =1.907	S.E. = 690.9

VAT losses:

NTAX1=NTAX1_PROC_M·TAX1/100 .

Personal income tax:

TAX2 = 0.1037387371·(ZARP/ZABZP) - 231.5200362·(@PCH(GOV2)/@PCH(DEFGDP)).

	(62.709)	(-2.298)
R^2 = 0.996	DW =2.575	S.E. = 151.374

Excise duty:

LOG(TAX3) = -2.95933241 + 0.9397966208·LOG(ZARP/ZABZP) + 0.2665973369·GOV3.

	(-6.396)	(15.278)	(0.991)
R^2 = 0.988	DW =2.018	S.E. = 0.336	

Land rent:

LOG(TAX5) = -1.547444297 + 1.001769604·LOG(RATE5).

	(-8.023)	(37.35)
R^2 = 0.995	DW =1.427	S.E. = 0.209

State duty:

1/LOG(TAX6) = 0.05979593283·LOG(GOV2) + 0.006271083018·(1/LOG(GOV6)).

	(2.775)	(42.49)
R^2 = 0.739	DW =1.899	S.E. = 0.236

Income tax:

LOG(TAX7) = -4.171087259 + 1.113438194·LOG(BASE7) + 5.304431121·RATE7 + 0.0238788037·TREND.

	(-16.317)	(20.35)	(3.73)	(1.44)
R^2 = 0.998	DW =2.537	S.E. = 0.067		

Tax on foreign economic activity:

1/LOG(TAX8) = -0.06397661699 + 2.878426109((1/LOG(M$·EO)) - 0.06248051978·GOV8

	(-3.397)	(18.417)	(-3.679)

0.001634614739·TREND.

	(-1.956)	
R^2 = 0.998	DW =3.079	S.E. = 0.003

Other proceeds:

TAX09=TAX09_STR·REV/100,

where: TAX1, TAX2, TAX3, TAX5, TAX6, TAX7, TAX - the proceeds according to the kinds of taxation; RATE5, RATE7 -tax rates; GOV1, GOV3, GOV6, GOV8 -artificial instrumental variables indicating the administration (fiscal) level pursuant to the kinds of taxes; ZARP, ZABZP - wages and salaries fund and wage arrears.

THE MODEL OF MONETARY AND CREDIT SECTOR:

Money supply:

M2/DEFGDP = 1.121960075·GDP96 - 116.6708509·RKN - 737.1711593·TREND2.

	(8.2706)	(-1.536)	(-4.891)
R^2 = 0.905	DW = 2.06	S.E. = 14907.1	

PCM2 =@PCH(M2) ·100

Money emission:

EMMO =EMMO(-1) · (1+EMMO_D/100)

Credit interest rate:

LOG(RKN) = 0.0001971569775·INFCPI + 0.9670027797·LOG(RKN(-1))

	(-2.99)	(46.32)	
R^2 = 0.772	DW =1.71	S.E. = 0.3882	

Money circulation rate (_2):

VM2f = 0.182280325·RKNf - 0.1732829754·RDN + 2.938641311

	(4.41)	(-4.06)	(1.89)
R^2 = 0.783	DW =0.85	S.E. = 1.5081	

GDP_MV = M2·VM2

GDP_MV_DIF = (GDP - GDP_MV)/GDP_MV·100

ANNEX 8 CGE Model: Methodology and Assumptions

Model Description

To study the economy-wide impact of HIV/AIDS in Ukraine, we use a Computable General Equilibrium (CGE) model. The literature contains a large range of different models (See e.g., de Melo [1988], Francois and Shiells [1994] or Devarajan and Robinson [2002]) for general surveys. The theoretical basis of the present modeling exercise is the applied general equilibrium framework discussed by Shoven and Whalley (1992). Based on this framework, we use a standard specification as, e.g., used in Harrison, Rutherford, and Tarr (1997a and b), the static model of Pavel (2001) or in the basic static specification of Jensen, Rutherford, and Tarr (2003). The model is programmed in GAMS/MPSGE as described in Rutherford (1999), an algebraic form of this standard specification can be found in Pavel (2001) or Rutherford and Paltsev (1999).

An overview of the model structure is in Figure A8-1. Production takes place under Constant Returns to Scale and all production factors are perfectly mobile. Consumers treat imported and domestically produced goods as imperfect substitutes while producers regard sales on domestic markets or exports as imperfect alternatives. This standard assumption is based on Armington (1996). Exports and imports are disaggregated into different trading partners, modeled with constant elasticities of transformation and substitution. Direct taxes are modeled as an activity-specific tax on the use of labor and capital (tax rates are negative if input/output tables report net subsidization). Indirect taxes are modeled as a commodity-specific tax on private (household) and investment demand (tax rates are negative if input/output tables report net subsidization). Import tariffs are commodity- and region-specific and apply for all imports.

Households are endowed with labor and capital and receive transfers. They spend a constant share of their income for investment goods. Final consumption is modeled by a Cobb-Douglas function of a representative household.

The government receives revenue from taxes and tariffs as well as from factor endowments. They use income to provide public goods. In all scenarios, the indirect tax rate adjusts endogenously so that the real value of public goods remains constant. Total investments equal the sum of depreciation, public and private savings, and the current account balance.

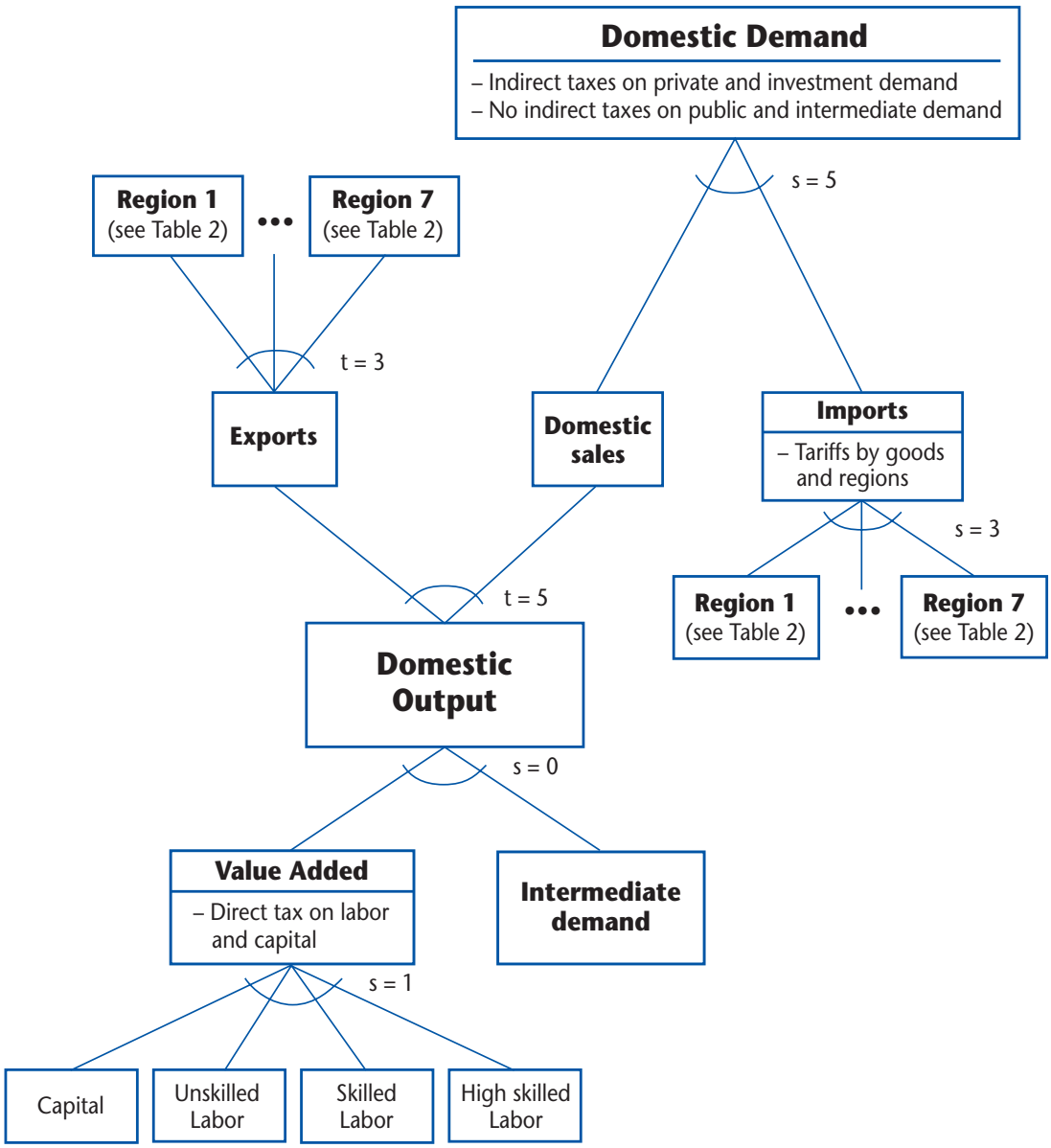
Since all supply and demand functions in our model are homogeneous of degree zero in prices, one price (the so-called numeraire) has to be fixed exogenously while all other endogenous price variables define the change relative to this numeraire. The choice of the numeraire as such has no impact on the results. In our model, we chose the price index for investment goods.

Data Requirements and Sources

The basis for our modeling exercise is a Social Accounting Matrix (see e.g., Pyatt and Round [1985]) compiled on the basis on Ukraine's National Accounts and Input-Output tables for 2001 (in basic and consumer prices).

Remuneration for labor has been disaggregated into three different categories using the 2001 edition of Labor of Ukraine (Pratsya Ukrainy) and the Statistical Yearbook 2002 of Ukraine.

Figure A8-1. CGE Model: Structure



Note: s denotes elasticity of substitution; t denotes elasticity of transformation.

Source: Institute for Economic Research and Policy Consultations model.

Parameter Parameters (taken from Jensen, Rutherford, and Tarr [2003])

Elasticity of substitution between labor and capital *1*
Elasticity of substitution between Value Added and Intermediates *0*
Elasticity of substitution between imports and domestic goods *5*
Elasticity of transformation between domestic output and exports *5*
Elasticity of substitution between imports of different origin *3*
Elasticity of transformation between exports to different destinations *3*

Table A8-1. CGE Model: Composition of Labor Endowment Decline

In percentage

Scenario	Labor endowment decline		
	Unskilled	*Skilled*	*High-skilled*
Pessimistic	0.016	0.063	0.063
Medium	0.008	0.031	0.031
Optimistic	0.006	0.023	0.023

Source: Authors' calculations.

Imports and exports in the Input-Output tables have been disaggregated into different origins and destinations using Ukraine's foreign trade statistics of the State Statistics Committee.

Input-Output tables include 38 activities/commodities. They have been aggregated to 20 sectors as explained in Table A8-6.

Exports and imports by activity and commodity are aggregated into the seven main trading regions (European Union, EU Accession Candidates, Russian Federation, CIS countries, Asia, North America, and rest of the World).

The Input-Output table contains information about two types of taxes, revenue from "taxes/subsidies on production" (direct taxes) and from "taxes/subsidies on commodities" (indirect taxes).

The rates of taxes and subsidies on production are calculated in percentage of labor and capital costs per industry.

Taxes and subsidies on commodities are split into import tariffs (commodity- and trade region-specific apply to all imports) and consumption taxes, including mainly VAT as well as excises and transit and road fees on specific products, (commodity specific on final and investment demand).

Data

National Accounts/Input-Output table for 2001

Labor of Ukraine 2001 (Pratsya Ukrainy 2001)

Statistical Digest, Kiev 2002

Foreign trade of Ukraine in 2001, vol.2, Statistical publication, State Statistics Committee of Ukraine, Kiev, 2002.

Cooperation between Ukraine and EU countries in 2002, Statistical publication, State Statistics Committee of Ukraine, Kiev, 2003.

Foreign trade of goods and services of Ukraine in 2002, Vol. 1, Statistical publication, State Statistics Committee of Ukraine, Kiev, 2003.

Model Application and Results

Reduction in Labor Supply.

The main channel through which the HIV/AIDS epidemic affects economic development is increased mortality and morbidity, which directly afflicts the labor force supply and productivity. A smaller overall population and labor force have their repercussions on the production side (the economy's production potential) and the expenditure side of the economy (final household consumption, residential fixed investment, and demand for government services).

According to the forecast by the Center for Social Studies of the Ministry of Labor and Social Policy of Ukraine (reported in Chapter 4), labor force endowment will decrease by 2 percent by 2014 in the baseline scenario. We consider 1.5 percent, 2 percent, and 4 percent decline in labor force endowment for optimistic, medium, and pessimistic scenarios respectively, based on the labor force projections of Chapter 4. The most pessimistic scenario in terms of labor supply shock is based on the projected magnitude of labor force decline in the most affected regions.

The prevalence of HIV is uneven within the labor force across different skill classes. We have assumed in what follows that the decline for skilled and high-skilled labor is four times larger than that for

Table A8-2. Structure of Ukrainian Economy (CGE Model)

Sectors	Structure of value added (in %)					TFP index		
	Capital	Labor (total)	Unskilled labor	Skilled labor	High skilled labor	SCENARIOS Pessimistic	Medium	Optimistic
Agriculture, hunting	0.81	0.19	0.15	0.02	0.02	0.997	0.998	0.999
Fishery	0.29	0.71	0.47	0.14	0.10	0.983	0.990	0.996
Mining of coal and peat	0.24	0.76	0.43	0.18	0.15	0.977	0.987	0.995
Production of non-energy materials	0.12	0.88	0.50	0.21	0.18	0.973	0.985	0.994
Food-processing industries	0.49	0.51	0.29	0.12	0.10	0.984	0.991	0.997
Textile and leather industry	0.44	0.56	0.32	0.13	0.11	0.983	0.990	0.996
Woodworking, pulp and paper industry, publishing	0.47	0.53	0.30	0.13	0.11	0.984	0.991	0.997
Petroleum refinement	0.76	0.24	0.13	0.06	0.05	0.993	0.996	0.998
Manufacture of chemicals, rubber and plastic products	0.39	0.61	0.34	0.14	0.12	0.982	0.989	0.996
Manufacture of other non-metallic products	0.30	0.70	0.40	0.17	0.14	0.979	0.988	0.995
Metallurgy and metal processing	0.43	0.57	0.32	0.14	0.11	0.983	0.990	0.996
Manufacture of machinery and equipment	0.33	0.67	0.38	0.16	0.13	0.980	0.988	0.996
Other	0.23	0.77	0.43	0.18	0.15	0.977	0.987	0.995
Electric energy	0.74	0.26	0.15	0.06	0.05	0.992	0.995	0.998
Public utilities	0.15	0.85	0.48	0.21	0.16	0.974	0.985	0.994
Construction	0.40	0.60	0.37	0.12	0.10	0.984	0.991	0.997
Trade	0.57	0.43	0.17	0.15	0.10	0.982	0.990	0.996
Hotels and restaurants	0.50	0.50	0.25	0.16	0.09	0.982	0.990	0.996
Transport	0.56	0.44	0.28	0.09	0.07	0.988	0.993	0.997
Post and telecommunications	0.61	0.39	0.21	0.10	0.08	0.987	0.993	0.997
Other services	0.32	0.68	0.18	0.18	0.31	0.966	0.980	0.993

Source: CGE model for Ukraine SAM 2001.

unskilled, replicating the actual epidemic patern in Ukraine, with urban population (predominantly skilled labor) being significantly more affected compared to the rural population (treated here as unskilled). This could mean that the average productivity of skilled and high-skilled labor would decrease and that overall demand for skilled and high-skilled labor could increase, making those skill classes scarcer. Since we did not find any evidence that people with university education are significantly less afflicted from HIV/AIDS, we did not distinguish between skilled and high-skilled, but assumed they incur identical HIV/AIDS prevalence and mortality rates. This resulted in the distribution of labor endowment decline among different skill classes.

As mentioned above, HIV/AIDS affects the availability of employees with specific qualifications. This

Table A8-3 CGE Model: Macroeconomic Implications of HIV/AIDS Epidemic, Scenario Analysis

Macro Indicators	Benchmark	Scenarios			Medium subscenarios		
		Pessimistic	Medium	Optimistic	Reduced labor	Lower TFP	Higher public spending
Welfare (equivalent variation, change in %)	-	-8.3	-4.6	-2.2	-2.6	-3.3	0.0
GDP Index (change in %)	-	-5.5	-3.1	-1.6	-1.8	-2.3	0.2
Private Investment (change in %)	-9.0	-5.0	-2.4	-2.8	-3.6	0.0	
Real factor return (change in %):							
– Return to capital	-	-7.03	-3.87	-1.90	-2.22	-2.55	-0.11
– Wage rate for unskilled labor	-	-7.46	-4.17	-1.78	-1.93	-3.55	-0.03
– Wage rate for skilled labor	-	-2.58	-1.70	0.07	0.55	-3.56	0.05
– Wage rate for highskilled labor	-	-1.42	-1.05	0.37	0.89	-3.18	0.14
Aggregate exports (UAH billion)	113.24	102.54	107.12	110.40	110.05	108.52	113.18
Aggregate imports (UAH billion)	109.92	99.09	103.74	107.05	106.69	105.18	109.84
Total exports (change in %)	-	-9.46	-5.41	-2.51	-2.82	-4.17	-0.06
Total imports (change in %)	-	-9.86	-5.63	-2.61	-2.94	-4.31	-0.08
Tariff revenue (share of public budget)	10%	9%	9%	10%	10%	10%	10%
Indirect tax revenue (share of public budget)	49%	55%	52%	51%	51%	51%	50%
Indirect tax rate (weighted average)	12%	15%	13%	12%	12%	12%	12%
Consumer Price Index (change in %)	-	-0.75	-0.42	-0.18	-0.20	-0.34	-0.01
Producer Price Index (change in %)	-	-3.01	-1.59	-0.66	-0.77	-0.90	-0.29
Real exchange rate (change in %)	-	-1.60	-0.77	-0.34	-0.43	-0.25	-0.19

Source: CGE model for Ukraine simulations.

follows from the changes in the working-age population brought about by increased mortality, but HIV/AIDS also affects the return to investment in skills, i.e., wages. In general, workers' deaths shrink the aggregate supply of labor, meaning that wages for workers with specific skills are likely to rise, or that workers who die will be replaced with others having less skill and less experience. On the other hand, the age structure of the working-age population changes: increased mortality means that employees are, on average, younger, and that individuals with substantial experience in their profession, normally a prerequisite for leading positions in a company, become scarcer.

Reduction in Labor Productivity

HIV/AIDS, by increasing morbidity and mortality, affects both the productivity of employees living with the disease and productivity in general. Productivity gradually declines because of increasing absenteeism and mortality, inflicting repercussions to both public and private sectors. This decline in worker productivity grows clearer as symptomatic AIDS progresses.

Since there is no evidence for Ukraine on the magnitude of decline of labor productivity due to HIV/AIDS, we used figures from a World Bank study

Table A8-4. CGE Model: Sectoral Implications of HIV/AIDS Epidemic, Scenario Analysis

Output index	Benchmark	Scenarios			Medium subscenarios		
		Pessimistic	Medium	Optimistic	Reduced labor	Lower TFP	Higher public spending
Agriculture, hunting	1.00	1.02	1.01	1.00	1.00	1.01	1.00
Fishery	1.00	0.99	1.00	1.00	0.99	1.00	1.00
Mining of coal and peat	1.00	0.91	0.95	0.98	0.97	0.97	1.00
Production of non-energy materials	1.00	0.67	0.81	0.91	0.91	0.84	1.00
Food-processing industries	1.00	0.98	0.99	1.00	0.99	1.00	1.00
Textile and leather industry	1.00	0.99	1.02	1.01	1.01	1.05	0.98
Woodworking, pulp and paper industry, publishing	1.00	1.03	1.03	1.01	1.00	1.04	1.00
Petroleum refinement	1.00	0.95	0.97	0.99	0.99	0.98	1.00
Manufacture of chemicals, rubber and plastic products	1.00	0.89	0.95	0.98	0.98	0.96	1.00
Manufacture of other non-metallic products	1.00	0.90	0.95	0.98	0.97	0.97	1.00
Metallurgy and metal processing	1.00	0.63	0.78	0.91	0.90	0.81	1.00
Manufacture of machinery and equipment	1.00	0.91	0.96	0.97	0.97	0.99	1.01
Other	1.00	0.74	0.84	0.93	0.93	0.86	1.00
Electric energy	1.00	0.90	0.95	0.98	0.97	0.96	1.00
Public utilities	1.00	0.94	0.97	0.98	0.98	0.98	1.00
Construction	1.00	0.93	0.96	0.98	0.98	0.98	1.00
Trade	1.00	0.94	0.97	0.98	0.98	0.98	1.00
Hotels and restaurants	1.00	1.21	1.12	1.04	1.04	1.12	1.00
Transport	1.00	1.20	1.11	1.04	1.04	1.10	1.00
Post and telecommunications	1.00	1.01	1.01	1.00	1.00	1.02	1.00
Other services	1.00	1.00	1.00	1.00	0.99	1.01	1.00

Source: CGE model for Ukraine simulations.

Note: All benchmark indexes equal unity (or 100 percent) reflecting the start position for the change.

on economic consequences of HIV in Russia (Rhuel, Pokrovsky, and Vinogradov 2002). They used a 13 percent reduction in productivity of the HIV-positive population. Nevertheless, due to low prevalence rate in Ukraine (1.98 percent, 2.34 percent, and 3.49 percent, respectively, by 2014), we assumed 1.5 percent, 4 percent, and 7 percent labor productivity reduction for optimistic, medium, and pessimistic scenarios, respectively.

We should mention that the HIV/AIDS epidemic has uneven sectoral impacts for the economy (e.g., Sharp 2002). Since HIV/AIDS directly harms labor productivity, we could expect that labor-intensive sectors (for example, metallurgy, mining, and non-energy sectors) will be afflicted most. On the other hand, specifics of each sector contribute to uneven HIV/AIDS effects. For example in the construction

Table A8-5. Implications for Sectoral Exports

Exports	Benchmark	Scenarios			Medium subscenarios		
		Pessimistic	Medium	Optimistic	Reduced labor	Lower TFP	Higher public spending
Agriculture, hunting	1.00	1.27	1.15	1.07	1.07	1.12	1.00
Fishery	1.00	1.00	1.01	1.00	1.00	1.01	1.00
Mining of coal and peat	1.00	0.85	0.92	0.96	0.96	0.94	1.00
Production of non-energy materials	1.00	0.62	0.78	0.90	0.89	0.81	1.00
Food-processing industries	1.00	1.06	1.04	1.02	1.02	1.03	1.00
Textile and leather industry	1.00	0.98	1.02	1.02	1.01	1.05	0.98
Woodworking, pulp and paper industry, publishing	1.00	1.06	1.05	1.01	1.01	1.06	1.00
Petroleum refinement	1.00	0.97	0.99	1.00	1.00	0.99	1.00
Manufacture of chemicals, rubber and plastic products	1.00	0.86	0.93	0.97	0.97	0.94	1.00
Manufacture of other non-metallic products	1.00	0.87	0.93	0.97	0.96	0.95	1.00
Metallurgy and metal processing	1.00	0.59	0.76	0.90	0.89	0.79	1.00
Manufacture of machinery and equipment	1.00	0.89	0.95	0.97	0.96	0.98	1.01
Other	1.00	0.65	0.79	0.91	0.90	0.81	1.00
Electric energy	1.00	1.00	1.00	1.00	1.00	1.01	1.00
Construction	1.00	0.95	0.98	0.99	0.98	1.00	1.00
Trade	1.00	1.02	1.02	1.00	1.00	1.03	1.00\
Hotels and restaurants	1.00	1.28	1.16	1.06	1.06	1.15	1.00
Transport	1.00	1.35	1.18	1.07	1.07	1.17	0.99
Post and telecommunications	1.00	1.16	1.09	1.03	1.03	1.09	1.00
Other services	1.00	0.93	0.97	0.98	0.97	1.00	1.01

Source: CGE model for Ukraine simulations.

Note: All benchmark indexes equal unity (or 100 percent) reflecting the start position for the change.

industry, the following factors facilitate the spread of epidemics: 1) work sites are often far from the homes of the laborers, 2) temporary housing for workers, and 3) few opportunities for leisure and entertainment. Employees in the transport sector, long distance truck drivers in particular, are also susceptible to HIV infection. They too spend a great deal of time away from home and often for long periods. Many of them have frequent contacts with commercial sex workers, many of them injecting drug users.

Increase in Public Spending

HIV/AIDS also erodes the government's financial resources, from both the revenue and the expenditure sides. Countries afflicted by the epidemic see their tax base and thus their domestic revenue grow more slowly or even shrink, even as demand for

Table A8-6. Classification of Activities and Goods in the Model and in Ukraine's Input-Output Tables

Model Classification	Input-Output Classification
a01 *Agriculture, hunting*	***a01*** *Agriculture, hunting*
a03 *Fishery*	***a03*** *Fishery*
a04 *Mining of coal and peat*	***a04*** *Mining of coal and peat*
a06 *Production of non-energy materials*	***a06*** *Production of non-energy materials*
a07 *Food-processing*	***a07*** *Food-processing*
a08 *Textile and leather*	***a08*** *Textile and leather*
a09 *Forestry, wood working, pulp and paper industry, publishing*	***a09*** *Wood working, pulp and paper industry, publishing* ***a02*** *Forestry*
a11 *Petroleum refinement, manufacture of coke products, production of hydrocarbons*	***a11*** *Petroleum refinement* ***a10*** *Manufacture of coke products* ***a05*** *Production of hydrocarbons*
a12 *Manufacture of chemicals, rubber and plastic products*	***a12*** *Manufacture of chemicals, rubber and plastic products*
a13 *Manufacture of other non-metallic mineral products*	***a13*** *Manufacture of other non-metallic mineral products*
a14 *Metallurgy and metal processing*	***a14*** *Metallurgy and metal processing*
a15 *Manufacture of machinery and equipment*	***a15*** *Manufacture of machinery and equipment*
a16 *Other production*	***a16*** *Other production*
a17 *Electric energy*	***a17*** *Electric energy*
a20 *Utility supply (water, gas, heat)*	***a20*** *Water supply* ***a18*** *Gas supply* ***a19*** *Heat supply*
a21 *Construction*	***a21*** *Construction*
a22 *Trade*	***a22*** *Trade*
a23 *Hotels and restaurants*	***a23*** *Hotels and restaurants*
a24 *Transport*	***a24*** *Transport*
a25 *Post and telecommunications*	***a25*** *Post and telecommunications*
a26 *Other services*	***a26*** *Financial intermediation* ***a27*** *Real estate transaction* ***a28*** *Renting* ***a29*** *Information activities* ***a30*** *Research and developmen* ***a31*** *Services to legal entities* ***a32*** *Public administration* ***a33*** *Education* ***a34*** *Health care and social assistance* ***a35*** *Sewage, cleaning of streets and refuse disposal* ***a36*** *Social activities* ***a37*** *Recreational, entertainment, cultural and sporting activities* ***a38*** *Other activities* ***a39*** *Financial intermediation services indirectly measured*

EXPLANATIONS: Service sectors (Financial intermediation, Real estate transactions, Renting, Information activities, Research and development, Services to legal entities, Public administration, Education, Health care and social assistance, Sewage, cleaning of streets and refuse disposal, Social activities, Recreational, entertainment, cultural and sporting activities, Other service activities) are added to a single service activity / commodity.

"Manufacture of coke products" (Activity/Commodity 10) has been added to "Production of hydrocarbons" and "Petroleum refinement" (Activity/Commodity 5 and 11, respectively) because of negative return to capital for "Manufacture of coke products."

"Heat supply" (Activity/Commodity 19) has been added to "Water supply" <20> and "Gas Supply" (Activity/Commodity 20 and 18, respectively) because of negative return to capital for "Heat supply."

"Forestry" (Activity/Commodity 2) has been added to "Wood working, pulp and paper industry, publishing" (Activity/Commodity 9) since a separation of exports and imports of "Forestry" by destination and origin is not possible.

Source: Authors.

Table A8-7. Structure of Ukraine's Economy (2001)

Activities / Commodities	Value added	Share in...	
		Total exports (by activity)	*Total imports (by commodity)*
Agriculture, hunting	0.16	0.05	0.01
Fishery	0.00	0.00	0.00
Mining of coal and peat	0.02	0.01	0.02
Production of non-energy materials	0.01	0.03	0.02
Food-processing industries	0.05	0.07	0.05
Textile and leather industry	0.01	0.04	0.06
Woodworking, pulp and paper industry, publishing	0.02	0.02	0.04
Petroleum refinement	0.03	0.05	0.31
Manufacture of chemicals, rubber and plastic products	0.02	0.08	0.11
Manufacture of other non-metallic products	0.01	0.01	0.01
Metallurgy and metal processing	0.04	0.30	0.08
Manufacture of machinery and equipment	0.05	0.12	0.18
Other	0.00	0.03	0.00
Electric energy	0.05	0.00	0.00
Public utilities	0.01	0.00	0.00
Construction	0.04	0.00	0.02
Trade	0.12	0.00	0.00
Hotels and restaurants	0.01	0.01	0.01
Transport	0.10	0.16	0.02
Post and telecommunications	0.03	0.00	0.00
Other services	0.22	0.02	0.06
Total	**1.00**	**1.00**	**1.00**

Source: National Accounts / Input Output table for 2001; authors' calculations.

health-related goods and services grows. The sector most directly affected by HIV/AIDS is the health sector. The demands on the public health service rise sharply with the spread of the epidemic. Ukraine has started to make theses treatments available through the public health service. According to the epidemic and cost scenario projections constructed in the earlier chapters, the public expenditure for HIV/AIDS treatment will increase within the range 0.2 percent, 2 percent, and 3.5 percent of the Ministry of Health budget, for optimistic, medium, and pessimistic scenarios, respectively.

Table A8-8. Structure of Output and Input (2001)

Code	Output (in %)			Input (in %)			
	Domestic sales	*Exports*	*Total*	*Intermediate demand*	*Value added*	*Depreciation*	*Total*
a01 b01 *Agriculture, hunting*	0.91	0.09	1.00	0.56	0.44	0.00	1.00
a03 b03 *Fishery*	0.83	0.17	1.00	0.65	0.30	0.05	1.00
a04 b04 *Mining of coal and peat*	0.95	0.05	1.00	0.70	0.29	0.01	1.00
a06 b06 *Production of non-energy materials*	0.54	0.46	1.00	0.75	0.25	0.00	1.00
a07 b07 *Food-processing industries*	0.83	0.17	1.00	0.82	0.18	0.00	1.00
a08 b08 *Textile and leather industry*	0.29	0.71	1.00	0.60	0.27	0.13	1.00
a09 b09 *Woodworking, pulp and paper industry, publishing*	0.65	0.35	1.00	0.64	0.36	0.00	1.00
a11 b11 *Petroleum refinement*	0.80	0.20	1.00	0.81	0.17	0.02	1.00
a12 b12 *Manufacture of chemicals, rubber and plastic products*	0.35	0.65	1.00	0.78	0.22	0.00	1.00
a13 b13 *Manufacture of other non-metallic products*	0.82	0.18	1.00	0.68	0.32	0.00	1.00
a14 b14 *Metallurgy and metal processing*	0.21	0.79	1.00	0.78	0.19	0.03	1.00
a15 b15 *Manufacture of machinery and equipment*	0.41	0.59	1.00	0.60	0.36	0.04	1.00
a16 b16 *Other*	0.44	0.56	1.00	0.87	0.13	0.00	1.00
a17 b17 *Electric energy*	0.98	0.02	1.00	0.53	0.47	0.00	1.00
a20 b20 *Public utilities*	1.00	0.00	1.00	0.75	0.25	0.00	1.00
a21 b21 *Construction*	0.99	0.01	1.00	0.60	0.40	0.00	1.00
a22 b22 *Trade*	1.00	0.00	1.00	0.43	0.57	0.00	1.00
a23 b23 *Hotels and restaurants*	0.43	0.57	1.00	0.56	0.44	0.00	1.00
a24 b24 *Transport*	0.46	0.54	1.00	0.42	0.58	0.00	1.00
a25 b25 *Post and telecommunications*	0.94	0.06	1.00	0.33	0.67	0.00	1.00
a26 b26 *Other services*	0.97	0.03	1.00	0.41	0.59	0.00	1.00

Source: National Accounts/Input-Output table for 2001; own calculations.

Bibliography

Ainsworth, M., L. Fransen, and M. Over, eds. 1998. *Confronting AIDS: Evidence from the Developing World.* Selected background papers for the World Bank Research Report, "Confronting AIDS: Public Priorities in a Global Epidemic," European Commission and The World Bank.

Amdzhadin, L., K. Kaschenkova, T. Konoplytska, O. Lysenko, A. Marusov, Y. Privalov, Y. Sayenko and O. Trofimenko. Forthcoming. "Behaviour Surveillance of Men Having Sex with Men Populations as a Component of the Second Generation HIV Surveillance." International HIV/AIDS Alliance in Ukraine, Kiev, in Ukrainian.

Anderson, R. M. 1988. "The Epidemiology of HIV Infection: Variable Incubation Plus Infectious Periods and Heterogeneity in Sexual Activity." *Journal of the Royal Statistical Society*, Series A (Statistics in Society) 151(1): 66-98.

Armington, P. 1969. "A Theory of Demand for Products Distinguished by Place of Production." International Monetary Fund Staff Paper 16, Washington, DC.

Arndt, C., and J. D. Lewis. 2001. "The HIV/AIDS Pandemic in South Africa: Sectoral Impacts and Unemployment." *Journal of International Development* 13(4): 427-49.

Artyukh, O. R., O. M. Balakireva, L. V. Bochkova, Y. P. Galilch, Y. M. Galustyan, D. M. Dikova-Favorska, O. G. Zlobina, N. M. Levchuk, V. P. Lyutyi, V. A. Martsynovska, T. P. Mykytyuk, V. F. Morozov, O. M. Petrovskyi, T. S. Shamota and O. O. Yaremenko. 2005a. "Behaviour Surveillance of Injecting Drug User Populations as a Component of the Second Generation HIV Surveillance." International HIV/AIDS Alliance in Ukraine, Kiev, 68 pages, in Ukrainian.

———. Forthcoming. "Behaviour Surveillance of Commercial Sex Worker Populations as a Component of the Second Generation HIV Surveillance." International HIV/AIDS Alliance in Ukraine, Kiev, in Ukrainian.

Bailey, N. T. J. 1988. "Simplified Modelling of the Population Dynamics of HIV/AIDS." *Journal of the Royal Statistical Society*, Series A (Statistics in Society) 151(1): 31-34.

Barnett, T., A. Whiteside, O. Balakireva, A. Scherbinskaya, et al. 2001. "The Social and Economic Impact of HIV and AIDS in Ukraine: A Re-Study." The British Council, Kiev, Ukraine.

Becker, N. G., and L. R. Egerton. 1994. "A Transmission Model for HIV with Application to the Australian Epidemic." *Mathematical Biosciences* 119(2): 205-24.

Becker, N. G., and I. C. Marschner. 1993. "A Method for Estimating the Age-Specific Relative Risk of HIV Infection from AIDS Incidence Data." *Biometrika* 80(1): 165-78.

Becker, N. G., and M. Motika. 1993. "Smoothed Non-parametric Back-Projection of AIDS Incidence Data with Adjustment for Therapy." *Mathematical Biosciences* 118(1): 1-3.

Becker, N. G., L. Watson, and J. Carlin. 1991. "A Method of Non-parametric Back-Projection and Its Application to AIDS Data." *Statistics in Medicine* 10: 1527-42.

Bell, C., S. Devarajan, and H. Hersbach (2004). "Thinking about the long-run economic costs of AIDS," in *The Macroeconomics of HIV/AIDS*, M. Haacker (ed). Washington, DC, International Monetary Fund: 96-144.

Bhargava, A., et al. 2001. "Modeling the Effects of Health on Economic Growth." *Journal of Health Economics* 20(3): 423-40.

Bloom, D. E., and J. D. Sachs. 1998. "Geography, Demography, and Economic Growth in Africa." Brookings Papers on Economic Activity 0(2): 207-73.

Boldsen, J. L., J. L. Jensen, J. Sogaard, and M. Sorensen. 1988. "On the Incubation Time Distribution and the Danish AIDS Data." *Journal of the Royal Statistical Society*, Series A (Statistics in Society) 151(1): 42-43.

Brainerd, E., and D. M. Cutler. 2005. "Autopsy of an Empire: Understanding Mortality in Russia and the Former Soviet Union." *Journal of Economic Perspectives* 19(1): 107-30.

Brown, D., and R. Stern. 2001. "Measurement and Modeling of the Economic Effects of Trade and Investment Barriers in Services." *Review of International Economics* 9(2): 262-86.

Castillo-Chávez, C. 1989. *Mathematical and Statistical Approaches to AIDS Epidemiology.* New York: Springer Verlag.

———. 2002. *Mathematical Approaches for Emerging and Reemerging Infectious Diseases: Models, Methods, and Theory.* New York: Springer.

Cuddington, J. T. 1993a. "Further Results on the Macroeconomic Effects of AIDS: The Dualistic, Labour-surplus Economy." *World Bank Economic Review* 7(3): 403-17.

———. 1993b. "Modeling the Macroeconomic Effects of AIDS, with an Application to Tanzania." *World Bank Economic Review* 7(2): 173-89.

Cuddington, J. T., and J. D. Hancock. 1994. "Assessing the Impact of AIDS on the Growth Path of the Malawian Economy." *Journal of Development Economics* 43(2): 363-68.

Cuddington, J. T., J. D. Hancock, and C. A. Rogers. 1994. "A Dynamic Aggregate Model of the AIDS Epidemic with Possible Policy Interventions." *Journal of Policy Modeling* 16(5): 473-96.

de Melo, J. 1988. "Computable General Equilibrium Models for Trade Policy Analysis in Developing Countries: A Survey." *Journal of Policy Modeling* Vol. 10.

DeBell, D., and R. Carter. 2005. "Impact of Transition on Public Health in Ukraine: Case Study of the HIV/AIDS Epidemic." *British Medical Journal* 331: 216-19.

Dee, P., K. Hanslow, and T. Phamduc. 2003. "Measuring the Costs of Barriers to Trade in Services." In *Trade in Services in the Asia-Pacific Region*, eds. Takotoshi Ito and Anne Krueger. Chicago: University of Chicago Press.

Derzhkomstat (Ukrainian Statistics Committee). 2004a. *Statistical Yearbook of Ukraine*, 2003. Derzhkomstat Ukrainy, Kiev, in Ukrainian.

———. 2004b. *National Accounts of Ukraine*, 2003. Derzhkomstat Ukrainy, Kiev, in Ukrainian.

Derzhkomstat (Ukrainian Statistics Committee). 2005. Population of Ukraine, 2004: Demographic Yearbook. Derzhkomstat Ukrainy, Kiev, in Ukrainian.

Devarajan, S., and S. Robinson. 2002. "The Influence of Computable General Equilibrium Models on Policy." TMD Discussion Paper No. 98. International Food Policy Research Institute (IFPRI), The World Bank, Washington, DC.

DHS (Department of Human Services). 1999. *Victorian Burden of Disease Study: Morbidity.* Public Health Division, Victorian Government Department of Human Services, Melbourne, Victoria.

Ethier, W. J. 1982. "National and International Returns to Scale in the Modern Theory of International Trade." *American Economic Review* 72(2): 389-405.

Feshbach, M., and C. Galvin. 2005. "HIV/AIDS in Ukraine-An Analysis of Statistics." Washington, DC, Woodrow Wilson International Center for Scholars: 34.

FitzSimons, D., V. Hardy, and K. Tolley. 1995. *The Economic and Social Impact of AIDS in Europe.* London: Cassell.

Francois, J.F., and C.R. Shiells. 1994. *Modeling Trade Policy: Applied General Equilibrium Models of North American Free Trade*, Cambridge: Cambridge University Press.

Freire, S. (2004). "Impact of HIV/AIDS on saving behaviour in South Africa". Forum paper for the conference *African development and poverty reduction: the macro-micro linkage*, Lord Charles Hotel, Somerset West, South Africa, 13-15 October.

German Advisory Group. 2004. "Ukrainian Steam Coal: Not Competitive or Just Mismanaged?" Advisory Paper T19, Kiev. Available at http://www.ier.kiev.ua/English/advis_eng.cgi.

Grossman, G. M., and E. Helpman. 1991. "Innovation and Growth in the Global Economy." Cambridge MA: MIT Press.

Haacker, M. 2002a. "The Economic Consequences of HIV/AIDS in Southern Africa." *IMF Working Paper* W/02/38: 41-95.

———. 2002b. "Modeling the Macroeconomic Impact of HIV/AIDS." *IMF Working Paper* W/02/195: 41-95.

———. 2004a. "HIV/AIDS: Impact on the Social Fabric and the Economy." In *The Macroeconomics of HIV/AIDS*, ed. M. Haacker. Washington, DC: International Monetary Fund.

———. ed. 2004b. *The Macroeconomics of HIV/AIDS.* Washington, DC: International Monetary Fund.

Harris, R. 1984. "Applied General Equilibrium Analysis of Small Open Economies with Scale Economies and Imperfect Competition." *The American Economic Review* 74(5): 1016-32.

Harrison, G. W., T. F. Rutherford, and D. Tarr. 1997a. "Economic Implications for Turkey of a Customs Union with the European Union." *European Economic Review* 41(3-5): 861-70, April.

———. 1997b. "Quantifying the Uruguay Round." *Economic Journal* 107: 1405-30, September.

Hartunian, N. S., C. N. Smart, and M. Thompson. 1981. *The Incidence and Economic Costs of Major Health Impairments: A Comparative Analysis of Cancer, Motor Vehicle Injuries, Coronary Heart Disease, and Stroke.* Lexington, Mass: Lexington Books.

Healy, M. J. R., and H. E. Tillett. 1988. "Short-Term Extrapolation of the AIDS Epidemic." *Journal of the Royal Statistical Society.* Series A (Statistics in Society) 151(1): 50-65.

Helpman, E., and P. Krugman. 1985. *Market Structure and Foreign Trade.* Cambridge, MA: MIT Press.

Ianchovichina, E., and W. Martin. 2001. "Trade Liberalization in China's Accession to the WTO." *Journal of Economic Integration* 16: 421-45.

IDSS (Institute for Demography and Social Studies). 2003. *Demographic Crisis in Ukraine: Causes and Consequences.* Institute for Demography and Social Studies, National Academy of Sciences, Kiev, Ukraine. State Statistics Committee (Derzhkomstat), in Ukrainian.

———. 2005. *Concept of Demographic Development, Ukraine, 2005-2015. Demography and Social Economics. Vol. 1.* Institute for Demography and Social Studies, National Academy of Sciences, Kiev, Ukraine, in Ukrainian.

ILO (International Labor Organization). 2004. *HIV/AIDS and Work: Global Estimates, Impact and Response.* Geneva: ILO: 101.

Isham, V. 1988. "Mathematical Modelling of the Transmission Dynamics of HIV Infection and AIDS: A Review." *Journal of the Royal Statistical Society.* Series A (Statistics in Society) 151(1): 5-30 and 44-49.

IUSSP (International Union for the Scientific Study of Population). 1993. 'AIDS Impact and Intervention in the Developing World: The Contribution of Demography and Social Science." Papers communications. Leige, Belgium: IUSSP.

Jager, J. C., E. J. Ruitenberg, and Commission of the European Communities, Working Party on AIDS. 1988. *Statistical Analysis and Mathematical Modelling of AIDS.* Oxford University Press.

Jensen, J., T. Rutherford, and D. Tarr. 2003. "Economy-wide and Sector Effects of Russia's Accession to the WTO." Mimeo.

Johnson, A. M. 1988. "Social and Behavioural Aspects of the HIV Epidemic-A Review." *Journal of the Royal Statistical Society.* Series A (Statistics in Society) 151(1): 99-119.

Kaplan, E. H., and M. L. Brandeau. 1994. *Modeling the AIDS Epidemic: Planning, Policy, and Prediction.* New York, NY: Raven Press.

Lewis, M. A. 1989. *AIDS in Developing Countries: Cost Issues and Policy Tradeoffs.* Washington, DC: Urban Institute Press; distributed by University Press of America.

Markusen, J.R., T. Rutherford, and D. Tarr. 2002. "Foreign Direct Investment in Services and the Domestic Market for Expertise." *Policy and Research Working Paper* 2413. Washington, DC: The World Bank.

Mathers, C., T. Vos, and C. Stephenson. 1999. The Burden of Disease and Injury in Australia. Catatalog Number PHE 18. Australian Institute for Health and Welfare, Canberra.

Mavrov, G., and G. Bondarenko 2002. "The Evolution of Sexually Transmitted Infections in the Ukraine," *Sexually Transmitted Infections* 78: 219-21.

Ministry of Economy and European Integration. 2004. *Monitoring of Macroeconomic and Sectoral Indicators.* Edition 2 (58): 5-88, Kiev, in Ukrainian.

Murray, C. J. L., and A. K. Acharya. 1997. "Understanding DALYs." *Journal of Health Economics* 16(6): 703-30.

Murray, C. J. L., et al. 2000. "Development of WHO Guidelines on Generalized Cost-Effectiveness Analysis." *Health Economics* 9(3): 235-51.

Murray, C. J. L., and A. D. Lopez, 2000. "Progress and Directions in Refining the Global Burden of Disease Approach: A Response to Williams." *Health Economics* 9(1): 69-82.

Murray, C. J. L., A. D. Lopez, and WHO (World Health Organization). 1994. *Global Comparative Assessments in the Health Sector: Disease Burden, Expenditures and Intervention Packages.* Geneva: WHO.

NBU (National Bank of Ukraine). 2004. *NBU Bulletin* 1: 70.

OECD (Organisation for Economic Co-operation and Development). 2003. "Achieving Ukraine's Agricultural Potential: Stimulating Agricultural Growth and Improving Rural Life." Executive Summary, Chapters 1-9, and Annexes 1-5. Working Party on Agricultural Policies and Markets.

Over, M. 2002. "The Macroeconomic Impact of HIV/AIDS in Sub-Saharan Africa." African Technical Working Paper Number 3, Population Health and Nutrition Division, Africa Technical Department, World Bank.

Pavel, F. 2001. *Success and Failure of Post-Communist Transition.* Achen: Shaker Verlag.

Pyatt, G., and J.I. Round. 1985. *Social Accounting Matrices: A Basis for Planning.* Washington, DC.

Robalino, D. A., C. Jenkins, and K. E. Maroufi. 2002. "The Risks and Macroeconomic Impact of HIV/AIDS in the Middle East and North Africa: Why Waiting to Intervene Can Be Costly." Policy Research Working Paper Series: 2874, World Bank, Washington, DC.

Robalino, D. A., A. Voetberg, and O. Picazo. 2002. "The Macroeconomic Impacts of AIDS in Kenya: Estimating Optimal Reduction Targets for the HIV/AIDS Incidence Rate." *Journal of Policy Modeling* 24(2): 195-218.

Ruehl, C., V. Pokrovsky and V. Vinogradov. 2002. "The Economic Consequences of HIV in Russia." World Bank, Moscow, Russia.

Rutherford, T.F. 1999. "Applied General Equilibrium Modeling with MPSGE as a GAMS Subsystem: An Overview of the Modeling Framework and Syntax." *Computational Economics* 14(1/2): October.

Rutherford, T., and S. Paltsev. 1999. "From an Input-Output Table to a General Equilibrium Model: Assessing the Excess Burden of Indirect Taxes in Russia." Draft, University of Colorado.

Schwartlander, B. A., K. A. B. Stanecki, T. C. Brown, P. O. B. Way, R. D. Monasch, J. E. Chin, D. F. Tarantola, and N. A. Walker. 1999. "Country-specific Estimates and Models of HIV and AIDS: Methods and Limitations." *AIDS* 13(17): 2445-58.

Sharp, S. 2004a. "Informing Policy through Modeling: A Case Study of the Socio-economic Implications of AIDS in Russia." Presentation, United Nations Development Programme (UNDP).

———. 2004b. "Modelling the Macroeconomic Implications of a Generalised AIDS Epidemic in the Russian Federation." In *Reversing the Epidemic: Facts and Policy Options*, ed. Bratislava, UNDP: 85-90.

Shoven, J.B., and J. Whalley. 1992. *Applying General Equilibrium.* Cambridge University Press.

SIFYA (State Institute on Family and Youth Affairs. 2004. *Family in Independent Ukraine (1991-2003).* Official Report on Family Issues in Ukraine. Kiev, in Ukrainian.

Stouthard, M., M. Essink-Bot, G. Bonsel, J. Barendregt, and P. Kramers. 1997. "Disability Weights for Diseases in the Netherlands." Department of Public Health, Erasmus University, Rotterdam.

UISS (Ukrainian Institute of Social Studies). 2002. "Gender Parity in the Emerging Modern Ukrainian Society." Kiev, in Ukrainian.

UNAIDS (Joint United Nations Programme on HIV/AIDS). 2002. "Improved Methods and Assumptions for Estimation of the HIV/AIDS Epidemic and Its Impact: Recommendations of the UNAIDS Reference Group on Estimates, Modelling and Projections: The UNAIDS Reference Group on Estimates, Modelling and Projections [Report]." *AIDS* 16(9): W1-W14.

UNDP (United Nations Development Program). 2004. "Reversing the Epidemic: Facts and Policy Options." UNDP, New York.

WHO (World Health Organization) Commission on Macroeconomics and Health, Ed. 2001. "Macroeconomics and Health: Investing in Health for Economic Development." WHO.

Wilkie, A. D. 1988. "An Actuarial Model for AIDS." *Journal of the Royal Statistical Society.* Series A (Statistics in Society) 151(1): 35-39.

The World Bank. 2003. "The Major Problems of Development of the Coal Sector and the Donbas Region." Concise Report, Kiev.

———. 2004. "Ukraine: Building Foundations for Sustainable Growth." A Country Economic Memorandum, Report No. 30928-UA, Poverty Reduction and Economic Management Unit, Europe and Central Asia Region, The World Bank, Washington, DC, 98 pages. http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2005/01/11/000160016_20050111155332/Rendered/PDF/309280UA.pdf


This map was produced by the Map Design Unit of The World Bank. The boundaries, colors, denominations and any other information shown on this map do not imply, on the part of The World Bank Group, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries.
UKRAINE
BELARUS
RUSSIAN FEDERATION
POLAND
SLOVAK REPUBLIC
HUNGARY
ROMANIA
MOLDOVA
BULGARIA
Black Sea
Sea of Azov
VOLYN
RIVNE
ZHYTOMYR
CHERNIHIV
SUMY
KYIV
POLTAVA
KHARKIV
LUHANSK
DONETSK
DNIPROPETROVSK
ZAPORIZHZHIA
KHERSON
MYKOLAÏV
ODESSA
KIROVOHRAD
CHERKASY
VINNYTSYA
KHMELNYTSKYI
TERNOPIL
IVANO-FRANKIVSK
ZAKARPAT
LVIV
CHERNIVTSI
CRIMEAN
Kovel
Sarny
Luts'k
Rivne
Korosten
Chernihiv
Sumy
Zhytomyr
KYIV (KIEV)
Kharkiv
L'viv
Ternopil'
Poltava
Khmel'nyts'kyi
Vinnytsya
Cherkasy
Kremenchuk
Sieverodonetsk
Luhans'k
Ivano-Frankivs'k
Uzhhorod
Chernivtsi
Uman'
Kirovohrad
Dnipropetrovs'k
Donets'k
Kryvyi Rih
Zaporizhzhia
Nykopol
Mariupol
Melitopol
Berdiansk
Mykolayiv
Kherson
Odessa
Izmail
Vilkova
Kerch
Yevpatoriia
Teodosiia
Simferopol'
Sevastopol
Yalta
Hora Hoverla (2061 m)
Carpathian Mts
Dnieper Upland
Dnieper Lowland
Donets Basin
Kyiv Reservoir
Kremenchug Reservoir
Kakhov Reservoir
Mouths of the Danube
North Bug
South Bug
Desna
Dnieper
Dniester
Donets
Inhulets
25°E
30°E
35°E
50°N
45°N
0 50 100 150 Kilometers
0 50 100 150 Miles
SELECTED CITIES AND TOWNS
OBLAST CAPITALS
NATIONAL CAPITAL
RIVERS
OBLAST BOUNDARIES
INTERNATIONAL BOUNDARIES
APRIL 2006
IBRD 34659

Ukraine, the second largest country in Europe, has achieved significant progress in macroeconomic stabilization and microeconomic reform during its transition toward a market economy over the past fifteen years. However, the gains from its economic recovery are threatened by an HIV/AIDS epidemic that started in 1987 and accelerated dramatically in 1995 when the virus penetrated the subpopulation of injecting drug users. At present, Ukraine's HIV/AIDS epidemic is among the fastest growing in Europe, with officially registered new HIV cases having doubled over 2000-2004. Official data suggest that Ukraine's epidemic may be on the brink of the generalized epidemic phase: by the end of 2004, the share of heterosexual mode of transmission has increased to almost a third of new cases. The spread of HIV/AIDS is superimposed on the adverse demographic situation characterized by both depopulation and deteriorating health status.

Socioeconomic Impact of HIV/AIDS in Ukraine was prompted by the need to assess the potential long-term impact of the rapidly growing HIV/AIDS epidemic in the country. It constructs a baseline demographic projection of the Ukrainian population for 1994-2014 and three epidemic scenarios for HIV/AIDS (medium, optimistic, and pessimistic) using low-high estimates of the size of and prevalence in most-at-risk populations. Model parameters include the rate of mother-to child transmission, the rate of progressions from HIV to AIDS, and availability of antiretroviral therapy.

Based on the epidemic scenario, the study estimates the effect of HIV/AIDS on the labor force, both at the national level and for the worst-affected regions. It also calculates direct budgetary impact due to disability, foregone revenue, and increased health care expenditure. Three macroeconomic models are constructed and applied to analyze macroeconomic costs of the epidemic in Ukraine: a simple growth model, a macroeconometric model, and a computable general equilibrium model. The latter two are multisectoral models evaluating differential effects of the epidemic on various sectors of economy.

The tools to curb the epidemic and its consequences both in human toll and economic hardship are at hand. **Socioeconomic Impact of HIV/AIDS in Ukraine** sets out clearly the reasons why those tools must be implemented now.