The HIV and AIDS Impact on the Rural and Urban Economy

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Introduction

The purpose of this chapter is to assess the impact of HIV and AIDS on economic growth in countries with different prevalence and economic structures and to suggest policy interventions to minimize the negative economic effects of this epidemic and avoid the widespread impoverishment of children in families infected or affected by HIV.

Economic growth and child welfare are simultaneously affected not only by HIV but also by other economic, military and social events, such as natural disasters, humanitarian conflicts and changes in terms of external trade. Disentangling the individual impact of each of these different effects is complex. It is possible – for instance – that the economic impact of HIV rises more than proportionately with the rise of prevalence. Also, it can be described as having 'a long wave effect', manifesting its impact after a time lag of 10 or even 20 years. Thus, countries where the epidemic is in its initial or intermediate stage feel a hardly perceptible impact on growth and poverty, and may therefore postpone the introduction of offsetting measures. Furthermore, the HIV phenomenon generates dynamic intersectoral and intergenerational effects that are not yet well understood or satisfactorily modelled. For instance, in Côte d'Ivoire, HIV prevalence rose initially in the urban sector but then gradually spread to the rural areas. In Yunnan (chapter 6), the epidemic developed initially among ethnic minorities but then spread among the dominant Han population. The impact of such shifts in prevalence on labour supply, aggregate growth, poverty, income distribution and public policy remains largely unexplored.

Economic impact of HIV: evidence from sectoral studies

The impact of HIV on the economy and child poverty is influenced by a variety of factors that change from country to country, but that always depend on prevalence (on average and by subgroups), the initial endowment of unskilled, semi-skilled and skilled labourers (teachers, doctors, managers, entrepreneurs), and changes in financial savings and capital accumulation. The economic impact also depends on whether or not production is based on highly specialized workers and on the modalities of saving formation, the existence of formal and informal health insurance, social safety nets and so on.

Impact on production via a decline in labour supply and lower productivity

The literature on the local-level impact of the HIV epidemic suggests that, as infection spreads among young and middle-aged workers, causing first illness and then, after a time lag of five to seven years, death, the total labour supply declines (ILO 1995). During the initial phase of the illness, the worker slowly starts losing his/her energy and productivity, due to a decline in body mass, energy, motivation and morale. This effect is not immediate, and an HIV-positive worker may carry on with a normal working life for some years after the onset of the infection. However, during the second phase, when AIDS has developed, there is nearly complete loss of work capacity and productivity. This stage can last up to two or three years, depending on the worker's nutritional status and access to health care.

Impact by skill level and sector of employment: There is little data to show a variation in the incidence of disease by skill level. Although a survey of blood donors in Malawi found higher infection levels among skilled than unskilled ones, in Zambia, from 1984 to 1992, AIDS caused 62 per cent of deaths among managers, a rate that was slightly lower than the 71 per cent for lower-level workers (ILO 2000; Ching'ambo 1995).

In contrast, the incidence of HIV and the number of deaths among workers vary significantly according to the sector of employment, as a number of occupational groups show higher than average rates of infection. Among them are those whose job entails considerable spatial mobility or interpersonal contacts, such as contract and transport workers, miners, fishermen, sales representatives and seasonal workers in agriculture, construction and tourism. Jobs that convey social status and power – as in the case of security personnel, teachers, health workers and wealthy managers – also exhibit higher than average rates of infection (ILO 2000). A survey of drivers in East Africa revealed an average infection rate of 33 per cent. And in one Zambian hospital, deaths among staff increased 13 times between 1980 and 1990, mainly because of AIDS. In the Kagera region of the United Republic of Tanzania, 55 health workers died of AIDS between 1987 and 1993; the increase was so pronounced that other health workers refused to be posted there. According to the South African Medical Research Council, approximately 25 per cent of miners are HIV-positive, while the AIDS Society believes the true figure to be nearer 45 per cent. A recent study of Carletonville, the centre of South Africa's gold industry, found that 60 per cent of women under 25 were infected (ILO 2000).

High levels of infection were also found on many commercial farms (FAO 1999a; Haslwimmer 1994). In Zimbabwe, in 1996, one major transport company with 11,500 workers found that 3,400 of them were HIV-positive (Whiteside 2000).

Impact on the rural labour force: The effects of HIV on agricultural growth are most immediate, as in this sector there are generally few possibilities for substituting a dwindling supply of labour with capital. Lack of skilled labour obliged farmers of several West African countries to delay some activities and, consequently, to obtain reduced yields (Black-Michaud 1997). On a Kenyan sugar estate, the spread of HIV among the wage labourers led to a 50 per cent drop in sugar output between 1993 and 1997 (ILO 2000). Between 1979 and 1991, per capita production fell in Mozambique (-3.1 per cent), United Republic of Tanzania (-1.4 per cent) and Uganda (-0.6 per cent) (Ruigu 1995).

The impact of HIV on farm productivity is also indirect. The care of sick relatives, participation in funerals and the sale of equipment following an HIV-related death contribute to a reduction in the labour supply and the productivity of uninfected workers. In Zimbabwe, an agricultural extension worker estimated that funerals took up to three days a month, or 10 per cent of his working time (Ncube 1999). In Zambia, an adult in an affected household loses 952 hours a year in personal sickness, with even more time needed for the care of the sick and funerals. In contrast, those in unaffected households take an average 518 hours off for personal sickness and 300 hours for care of the sick and attending funerals (Bangwe 1997). In Namibia, 25 per cent of the production time in critical periods was lost due to mourning alone (Engh et al. 2000). And Tibaijuca (1997) found that in the Kagera region of the United Republic of Tanzania, 81 per cent of the respondents felt that hired labour was difficult to find, and wages increased tremendously over the decade.

HIV also affects long-term rural growth, as it interrupts the transmission of farming knowledge across generations (du Guerny 1999). Barnett's (1994) study on Uganda, United Republic of Tanzania and Zambia confirms that mortality seems to have a greater impact than morbidity in rural areas, not only because of labour loss, but also as a result of the termination of farming knowledge.

Responses by farmers to the impact of HIV: Farmers adopt a series of adjustments to respond to the decline in their workpower. In a first phase, they may increase the family labour supply. In Zambia, heads of households in HIV-affected families responded to loss of workpower among adults by teaching and supervising male teenagers to take over the fields. The spontaneous pooling of community labour resources is another way in which farmers have their land farmed, despite rising HIV infection within their family.

Some affected households grow less labour-intensive crops. Studies of African smallholders find that affected families in Uganda substituted resource-intensive cash crops – such as coffee or tomatoes – for less labour-intensive crops such as cassava (Topouzis 1994; Mutangadura et al. 1999a; Rugalema 1999; du Guerny 1999). Similar strategies were employed in the communal agricultural systems of Zimbabwe (Kwaramba 1997) and in the north of Côte d'Ivoire (Black-Michaud 1997). The death of an income earner may lead to a decline in purchased inputs and the sale of draught power and farm implements to cover medical and funeral expenses (Ncube 1999). When these adjustments prove insufficient, the affected households reduce crop cultivation, especially in outlying fields.

These adjustments can generate a permanent economic impact due to a decline in soil fertility. As shown in a number of studies, agricultural practices such as regular weeding and maintenance of irrigation systems may be neglected. In extreme cases, food plantations have reverted to the wild. In the commercial sector of Kenya, much of the fertile land of families hard hit by the epidemic remains idle due to labour shortages (Rugalema 1999). Waller's (1996) study on the impact of farming in the Monze district of Zambia shows that the poorest households reduced the cultivated area and 10 out of 15 of them reverted to zero-tillage. Land fertility may be affected over the long term by a drop in the use of fertilizers. In Zambia, 90 per cent of farmers had either stopped using fertilizer altogether or reduced the quantity below the recommended amount (Waller 1996). The livestock sector also suffers in that there is an increase in the morbidity/mortality of animals and fewer livestock products. In Gweru, some cattle died or were stolen when they could no longer be herded properly (Ncube 1999).

Impact on the urban labour force: The impact of HIV on the skilled urban labour force may be less immediate – because of greater possibilities of substitution of labour with capital – but HIV-related deaths cause greater damage, as the possibility of replacing highly skilled workers is generally lower and its costs higher. A study of enterprises in South Africa found that fewer than 40 per cent of the employers believed they had a good chance of replacing skilled workers (ILO 2000). And rapid turnover means loss of valuable experience as happened in the Uganda Railway Corporation. Absenteeism is another problem. Studies of businesses in East Africa show that it accounts for between a quarter and a half of the HIV/AIDS cost because of the disruption of the production cycle, underutilization of equipment and the cost of hiring temporary staff (ILO 2000).

Impact on savings and capital accumulation

Another impact of HIV on growth is through a slowdown in the formation of public and private savings and their investment in productive capital. Such impact is not straightforward and is scarcely documented. While public savings and infrastructure are likely to diminish – because of the increased pressure on current expenditure – the impact on household savings and firm profits is more difficult to predict and is likely to depend on the extent to which the additional health and welfare expenditures are borne by the households concerned or by the public sector.

In principle, HIV should raise the pressure to increase household savings (for future health care, funerals and obligatory bequests) while at the same time reducing them (due to impoverishment and increased current health costs).

The evidence reviewed in chapter 8 and the country case studies seems to suggest that the additional costs incurred through the spread of HIV were mainly covered by the households in low-income countries and by the state budget in the middle-income ones. The Monze study on farming households shows that 33 per cent of the households studied felt that high medical fees cut into farming investments, particularly for livestock (Waller 1996).

A study on Benin (UNDP 1998) records a fall in savings in 84 per cent of the 68 families with a member employed in the formal sector who died of AIDS. The study of the Rakai district in Uganda by Menon et al. (1997) shows that the households affected by an HIV-related death lost their savings and were forced to sell their properties to pay for health care and funeral expenditures to a greater extent than households affected by other types of death.

As for earnings, a study of female traders in the Owino market in Uganda shows how quickly they can lose their livelihoods. The majority of market women trade in perishable goods (vegetables, fish, fruit, cooked food), that require short turnaround time: business collapses when women attend to the sick for long periods. Moreover, many have had to forfeit their stalls in the market and are unable to resume trading after their personal savings have been depleted (Sentongo 1995). An ILO (1999b) workshop came to the conclusion that many of the HIV-infected workers in the informal sector can no longer afford their premises, so their businesses collapse. And in Zimbabwe, the households studied lost half a million Zimbabwean Dollars in earnings during the 1997–1998 agricultural season because of their inability to cultivate their land (Ncube 1999).

Impact on earnings and profits for commercial enterprises

Given a fixed supply of labour for each skill category, HIV may have the effect of increasing wages and enterprise costs (e.g. for health insurance) and – assuming competitive product markets – of compressing profits, but this effect ought to be much less pronounced in countries with an excess labour supply.

In many countries, commercial farms suffer sharp cuts in output and profits as a result of the loss of workers and decreased working hours due to illness, death, stress, attendance at funerals and home care of ill dependants. In the United Republic of Tanzania and Zambia large urban sector companies reported that HIV-related health costs surpassed their total annual profits, while in Botswana, large companies estimated that HIV-related costs would increase from under 1 per cent to 5 per cent of the wage bill in six years (ILO 2000).

In Zambia, in 1993, the medical expenses incurred by the INDENI Petroleum Refinery were 1.2 times the net profits, and millions of Kwacha were paid to relatives of ill employees in the form of basic salaries and funeral grants (Ching'ambo 1995). Similar findings are reported from Zimbabwe (Guinness and Alban 2000) and Botswana and Kenya (Roberts and Rau 1995; Bollinger and Stover 1999, p. 4).

The impact on profits may, however, be offset by restructuring that reduces the legal obligations of companies to their workers. In Tanzania, the Economic Recovery Programme allowed organizations to get rid of employees living with HIV (Moshi 1995). Kad'iebwe's (1995) study of the impact of HIV on the labour force in Rwanda from April 1992 to March 1993 shows that the immediate dismissal and replacement of middle and senior personnel was common.

Impact on consumption

Although families reduce their savings, sell assets and borrow from friends and relatives, the decline in income due to HIV invariably results in lower consumption levels. This can permanently affect the welfare of children and their families, particularly when essential expenditures, such as food and schooling, are reduced.

But this fall in consumption may be temporary. Béchu (1998) shows that urban households of Côte d'Ivoire where a person infected with HIV died showed a 28 per cent fall in per capita consumption of basic needs, but consumption recovered during the following year, so the overall reduction amounted to 12 per cent. Janjaroen's (1997) analysis confirms these findings in the case of Thailand. Lundberg et al. (2000) suggest that the lower income group affected by HIV experience a 30 per cent fall in food expenditure over the short term.

In urban areas of Côte d'Ivoire, the proportion of the household budget spent on health care is 10.6 per cent for people affected by HIV and 5.6 per cent for people affected by other illnesses (Béchu 1998). UNAIDS (2000) shows that, in these areas, families reduced their outlay on education by half, while average spending on health care went up four times. Likewise, Over et al. (1989) found that in Kagera, United Republic of Tanzania, health-care expenditures were 8 per cent of annual household expenditures in those affected by HIV, and 0.8 per cent in those not affected.

Impact on government expenditure

Another impact of HIV arises from the need to increase government expenditure on health, teacher training and welfare transfers, while tax revenue is declining. This can lead to growing budget deficits and, eventually, to the adoption of restrictive adjustment policies. Alternatively, if the deficit is covered through public bonds, it can lead to higher inflation or a rapid accumulation of public debt.

Though there are few convincing analyses in this area, it may well be that – except for economies counting on large mineral rents (as in Botswana) – tax revenue may decline because of the slowdown in economic activity induced by HIV. Much will depend on the sector affected the most, whether it is the urban (and more easily taxable) sector or the rural and informal sector that generally contributes less to state taxes. Meanwhile, it is likely that non-HIV-related expenditure on health, education, the training of teachers, nurses, food subsidies, and other social programmes may fall. As noted, health and social welfare systems are being affected by a surge in health spending on HIV and pressures to introduce orphan and other allowances. This may in turn affect mortality/morbidity and other aspects of child well-being in communities unaffected by HIV.

Assessment of the overall impact of HIV on the economy

Many of the studies reviewed above are local-level analyses (often based on a small number of observations), the results of which cannot necessarily be extrapolated to the national level. Moreover, the analyses do not examine the systemic effects. The overall impact of HIV is therefore assessed below through studies that rely on different approaches.

Microeconomic approach: estimating the impact on a sample of HIV-affected families

Some studies try to assess the economic impact of HIV by computing the loss of household income and the greater medical and other costs incurred over a given period of time by the families affected by HIV, in relation to unaffected families with similar socioeconomic characteristics. Such an approach normally calls for identification of a representative sample of HIV-affected households and an equally representative control group; measurement of the average income loss and higher costs incurred by the HIV-affected family in relation to the control group; actualization of all income losses and greater costs at one point in time; and extrapolation of the 'unit cost of HIV per affected family' to the total number of families affected by HIV at that point in time, divided by GDP.

Anand et al. (1999) assess the total annual cost of HIV for the period 1986–1995 in India under different (low, medium and high) estimates of HIV prevalence. The total annual cost of HIV includes: the loss of productivity among patients with HIV-related illness due to sickness and death; HIV caregivers' loss of productivity; and the cost of management of patients with HIV-related illness. The loss of output due to HIV is estimated in rural and urban areas separately, through a life table approach, using two cohorts, one with and one without HIV: the difference in person-years lived between the two scenarios is then converted into monetary terms by means of the national per capita income for 1992–1993. The loss of productivity among working, but enfeebled, patients with HIV-related illness is estimated by relying on current data and expert opinion. An HIV-positive person is assumed to need six hospital admissions for HIV-related illnesses before death, for an estimated total of 100–200 hospital days. The study concludes that the estimated annual cost of HIV ranges between 0.1 per cent and 1.1 per cent of GDP, depending on the assumption made about prevalence.

This kind of study could be improved in some respects. It would make sense to disaggregate the economy into its rural and urban components, as incomes, hospitalization rates, care patterns and so on differ substantially between the two. Moreover, these analyses are static, as the surveys are taken at one point in time and cannot therefore capture the interaction between the impact of HIV (on labour supply, income, consumption, etc.) and the subsequent reactions by the families and communities affected. The studies only provide a partial analysis of the phenomenon at hand, as they reflect the changes that occur in the HIV-affected sector, but not their interaction with the rest of the economy. Another drawback is what may be termed the micro–macro inconsistency or aggregation bias. In extrapolating income losses from the micro to the macro level, it is assumed that all workers are fully occupied, but this is seldom the case. In reality, an income loss at the micro level, although it results in the severe impoverishment of a family, may cause no perceptible contraction in GDP because the loss of output due to the death of a worker is made up by a previously unemployed one taking his or her place. The aggregate impact may also change because of the adoption of policies facilitating the substitution of labour with capital.

Macroeconomic approach

Another approach to the estimation of the impact of HIV is to build partial equilibrium or computable general equilibrium (CGE) models, in which GDP is a function of the stocks of production factors (physical capital, land, labour and human capital) that are, in turn, eroded by HIV in a variety of ways. The most prominent of such models are discussed below:

(i) Kambou et al. (1992) built one of the first detailed CGE models to assess the impact of HIV in Cameroon. The model is calibrated on the years 1979–1980 and includes a multisectoral production function that captures intersectoral interactions through prices and demand effects. It also includes a detailed treatment of the government and household sectors. On the production side, there are three categories of labour (rural, urban-skilled and urban-unskilled) that cannot be substituted for each other, while investment is driven by domestic savings. The world demand and prices for Cameroonian exports and the net capital inflows remain unchanged and government expenditure is constant.

This model is closer to the real world than most other studies reviewed in this chapter, but its conclusions are affected by problems. First, as in all CGE models, the structural parameters are not estimated econometrically, but are assigned values derived from the literature that are then ‘calibrated’ to make the model reproduce the correct value of the dependent variables. Such a procedure has obvious limitations. Furthermore, the calibration is carried out with reference to 1979–1980, when the HIV prevalence was very low and AIDS had not manifested its impact. Also, as in most other studies reviewed, no allowance is made for excess labour supply. The model is also not 'dynamic' in that it is a sequence of static models obtained by updating variables over time, a fact that does not capture the cumulative effects of the relation between HIV and the economy, and makes no difference between the different stages of HIV and AIDS. Finally, the model assumes there are no financial assets, while it is plausible that one of the main impacts of HIV is precisely via the financial sector.

(ii) Over (1992) built a model to estimate the impact of HIV on the growth of GDP per capita in 30 African countries over the period 1990 to 2025, under alternative assumptions about the distribution of the epidemic and the financing of the costs it generates. The author represents the growth process using two generalized Cobb–Douglas production functions, one for the rural sector (making use of unskilled labour and farmable land, the supply of which expands at a given annual rate) and one for the urban sector (making use of skilled labour and capital). The capital stock in the urban sector rises in line with the yearly gross investment, i.e. total foreign and domestic savings. The labour force in each year is disaggregated into six groups, according to educational achievement and sector of work. The risk of contagion rises with the workers' level of education, which means that the loss of labour is greater in an economy with more educated workers. The cost of treating HIV is also assumed to rise steeply in line with the level of education. The model shows that, when a proportion of the cost of treating HIV is financed from private savings, the negative impact on growth of GDP is greater. The model's main conclusion is that raising the share of the treatment cost financed from savings, or assuming that the epidemic affects productive workers more, increases the negative impact on income growth. Overall, HIV is shown to depress GDP growth rates by some 0.33 per cent a year.

(iii) In 1994, Over produced a model with Ainsworth to assess the impact of HIV on per capita income, through changes in the capital output ratio, the cost of HIV treatment to per capita income, and the proportion of the treatment costs financed from savings. The extent of the economic impact is determined by prevalence and incubation period. They assume that the national output is produced through work and capital, that HIV has an incubation period ranging between 5 and 10 years, and that a country has a steady HIV prevalence of 10 per cent. Every 10 per cent increase in the epidemic slows the growth of the workforce by 0.6–1.0 per cent a year. About half of the costs for HIV treatment are financed through savings; this results in reduction of the growth rate of capital accumulation. These assumptions lead to the conclusion that the fall in the growth rate of per capita income ranges from 0.1 per cent if the national prevalence is 10 per cent and the incubation period is 10 years, to 0.8 per cent if the prevalence is 30 per cent and the incubation period five years. Despite its pioneering nature, the model is too aggregate and somewhat simplistic.

(iv) Another macro CGE study on the impact of the HIV epidemic in South Africa is that by Arndt and Lewis (2000), who built a disaggregated economy-wide simulation model including 14 sectors, 5 production factors, 5 households quintiles, and 10 government expenditure categories. The estimates of labour supply, AIDS and non-AIDS death rates and HIV prevalence are derived from the extrapolations of Quattek (2000). AIDS deaths are assumed to affect the economy by reducing the workers in each skill class proportionately, while HIV-positive workers are half as productive as non-affected workers. The model's simulations show that the GDP growth rate declines gradually over time, to reach a maximum fall of 2.6 per cent in 2008. The result, however, suffers from shortcomings similar to the other CGE models discussed above.

(v) A non-CGE model by BER (2001) also attempts to quantify the macro impact of HIV in South Africa during the period 2000–2015, with the main emphasis being on sensitivity analysis rather than precise point estimates. As do other models for South Africa, it makes use of the Actuarial Society of South Africa (ASSA) model for all demographic projections for population groups by age, gender, skill and area. It estimates that a fall in the population and labour force efficiency would lead to a 21 per cent reduction in productivity. Secondly, greater costs to the business sector for pension, disability and medical benefits would add 5 per cent to the skilled employee wage bill by 2005 and double that by 2010. Companies would pass on 50 per cent of this cost in prices and absorb the rest through a cut in profits. The business sector would also bear higher costs for recruitment and training as well as absenteeism and lower staff morale that would reduce productivity by up to 40 per cent. The Government would have to increase expenditure, taxes and the deficit, while cutting public health expenditure in the non-HIV sector, and doubling it for HIV in order to employ additional health staff and purchase health inputs for those affected. More funds would be needed for fostering children orphaned by AIDS. At the household level, families would have to finance half their additional HIV-related expenditures from personal savings and half by reducing purchase of goods and services. The model forecasts that GDP will be 1.5 per cent lower by 2010 and 5.7 per cent lower by 2015, i.e. values that are somehow lower than those estimated in other studies.

(vi) The BIDPA (2000b) study on the impact of HIV in Botswana makes use of household and individual data from a 1993/4 survey. The study predicts that by 2010, 49 per cent of households will have at least one infected member, 7 per cent will have disappeared and 26 per cent will lose income as a result of the death of a family member.

The analysis evaluates the impact of HIV on income and expenditures over a 10-year period (by which time HIV-infected people are expected to have died), assuming a 5.7 per cent reduction in the overall unemployment rate and a 12.2 per cent increase in the wages of skilled workers (but not of the unskilled ones). The additional medical and funeral expenditures are estimated on the basis of discussions with general practitioners and are included among the household expenditures. Households are assumed to spend an additional 25 per cent of their income on each person infected with HIV. The study predicts an 8 per cent fall in income per capita and a 5 per cent rise in the number of the people living in poor households, with no change in income inequality, but an increase in the dependency ratio. The situation of the first quartile of households is the worst, as their income and dependency ratios deteriorate more than the average. The introduction of medical and funeral expenditures does not change the income levels but does increase the incidence of poverty. However, the model results depend on too many assumptions, a fact that makes the estimate of the HIV impact too hypothetical.

(vii) In the Quattek (2000) model, the impact of HIV on each sector depends on the mix of workers between unskilled workers (who have infection rates of 30 per cent and are assumed to cause no additional costs as they are less likely to be covered by health and other benefits) and skilled and highly skilled workers, who are proportionately less affected by HIV (their infection rates reach 23 per cent and 13 per cent respectively) but have a high replacement cost. Transport, storage, catering and accommodation are the sectors most exposed to the HIV epidemic, while machinery, communication and metals fare relatively better, and service industries such as finance and business rank in the middle. The impact of HIV is estimated by assuming a work loss of four months per person-year, weighted by skills, for every person diagnosed with AIDS.

The model estimates that between 2006 and 2015, GDP would rise an average 0.3–0.4 per cent a year and domestic savings would be 2 per cent less than in the absence of HIV, while the consumer price index would increase due to higher interest rates and cost pressures on companies. However, capital-intensive technologies would sustain investment.

(viii) Nicholls et al. (2000) model the macroeconomic impact of HIV for Trinidad and Tobago and Jamaica. They assume a three-sector economy (agriculture, industry and services) with a Cobb–Douglas production function and male and female labour markets for all three sectors. Domestic savings are proportional to income and finance all investments but are affected negatively by expenditures on AIDS drugs, HIV tests and hospitalization. In this model, HIV prevalence rises by 20 per cent between 1997 and 2005. The simulation leads to the conclusion that GDP in Jamaica and Trinidad and Tobago would decline by an average 6.4 per cent and 4.2 per cent respectively. These estimates may seem excessive, since the cost of treating HIV has significantly declined, and there are no dynamic changes in dependency ratios or investments in human capital.

(ix) Cuesta (2001) builds a partial equilibrium model for Honduras that includes a Cobb–Douglas production function. The model simulations assume alternative HIV and AIDS incidence rates, while all other variables are kept constant in real terms. The simulation of 10 alternative scenarios with different levels of HIV incidence, financing of HIV treatment and environmental conditions suggests that the growth impact ranges between 0.7 per cent and 2.7 per cent a year, and is mainly due to the negative impact on labour availability rather than on capital accumulation.

In conclusion, although the CGE and partial equilibrium approach gives an adequate representation of the structural relationships between an economy and the direct and indirect effects of HIV, it does suffer from a few shortcomings: It provides estimates that depend on a large set of assumptions and tend to be country specific, even when sensitivity analysis is carried out; CGE models are usually not estimated econometrically and offer few insights into the impact of the epidemic across sectors or social groups; and the models are limited in their simulations of policy interventions in the field of health care financing, orphan allowances and accelerated formation of production factors.

Cross-country regressions

This class of model examines the relationship between changes in GDP growth rates in countries affected by different HIV prevalence and AIDS death rates at one point in time, or over a period of time, after controlling for as many variables as possible. One such study is that by Bloom and Mahal (1997), who dismiss the claim that HIV reduces the growth of the economy, on the basis of cross-country regression analysis for 51 countries between 1980 and 1992 and 1987 and 1992. The study shows that, over both periods, the negative relationship between economic growth and the rise in HIV prevalence is a spurious one, explained by the fact that HIV increased most in countries with low income per capita. The authors conclude that the HIV epidemic has had an imperceptible effect on the growth rate of GDP and per capita income.

However, these strong conclusions are weakened by a number of technical and theoretical problems. The HIV and AIDS data utilized in the study come from different, and possibly inconsistent, sources. Also, both periods analysed had a low number of AIDS cases, even when HIV prevalence started to rise. The impact of AIDS and HIV on GDP and GDP per capita tends to be quite different, so that the overall impact may change over time. It is not clear from the model whether HIV affects the economy, through a decline in the labour force, the differential spread of the epidemic in rural and urban areas, diversion of scarce public expenditure to the prevention and treatment of HIV, or other factors.

In a cross-sectional study of some 70–80 low- and middle-income countries from 1990 to 1997, Bonnel (2000b) comes to rather different conclusions and suggests that, while in low-prevalence countries the growth impact is negligible, for Africa as a whole, the growth of per capita income was reduced by 0.7 percentage points a year. In the words of the author, in the absence of HIV, ‘Africa’s income per capita would have grown at 1.1 per cent a year – as opposed to the 0.4 per cent achieved from 1990 to 1997'. A country with a 20 per cent HIV prevalence would see its per capita GDP growth rate drop by 2.6 per cent a year.

Cross-country regressions are subject to a number of criticisms. While both studies cited above tried to include all the necessary variables, it is not clear that they succeeded in accounting for all the factors that may affect growth, and/or HIV prevalence. Neither study allows for any time lag between the rise of HIV prevalence and the impact on GDP growth. The use of period averages over several years for both per capita income growth and HIV prevalence conceals the cumulative effect of rising prevalence on GDP growth. Neither study takes into account the fact that the impact of HIV on growth depends on whether or not labour is fully employed, and that the effect of HIV varies according to the sector and level of labour skills involved. In the Bonnel (2000b) study, there is no empirical support for the proposition that the HIV impact on growth depends on the effectiveness of policy and regulations.

Regressions on panel data

Econometric analyses conducted on panel data are in principle able to correct for several of the methodological problems encountered in cross-country regressions and to best capture the impact of HIV on economic growth, even if such impact may have been quite modest until recently in several countries.

Dixon et al. (2001) try to assess the impact of the HIV epidemic on growth by means of an econometric model, covering 41 African countries over the period 1960 to 1998. The model predicts a reduction of 1.3 per cent in economic growth at an HIV prevalence of 20 per cent. This growth reduction is about half that estimated by Bonnel (2000). Dixon's model is, however, highly aggregated and misses some of the real life interactions between HIV and the economy. It assumes full employment of all the labour force and does not allow for the existence of a labour surplus that would nullify the impact of the loss of skilled workers. Moreover, the model makes no distinction between HIV and AIDS. In addition, it suffers from a few estimation problems, as some of the coefficients (on education and health capital) are not significant, or indicate the wrong correlation between variables.

Table 1 summarizes the main results of the studies reviewed above in terms of the impact of HIV on GDP growth. These results are not immediately comparable, as they sometimes refer to rather different assumptions about HIV prevalence, and in some cases reflect the influence of specific country situations. But the studies summarized in table 1 do suggest a few important conclusions: First, the impact of HIV tends to be imperceptible in countries with HIV prevalence of less than 3–4 per cent. Second, most studies suggest that a mature epidemic (5–20 per cent and above) can reduce the growth rate by 0.5–1.0 GDP growth points a year, an impact that is certainly costly when it is sustained over the medium and long term. Finally, the studies that refer to the entire economy generate GDP impact results that are substantially lower than those derived from local surveys in the country case studies, where it appears that an affected family loses some 30–40 per cent of its income. This means that in countries – such as Botswana – where HIV prevalence exceeds 35 per cent, GDP should have declined by some 10.5–14 percentage points, a result that is at variance with both the studies reviewed above and empirical observation.

Table 1. Summary of the annual reduction in GDP growth rate per year due to HIV identified in studies based on macro, micro, cross-country and panel data

Country	Reference	Average reduction in annual GDP growth rate
India	Anand et al. (1999)	0.1–1.0
Cameroon	Kambou et al.(1992)	1.9
South Africa	Arndt and Lewis (2000)	1.4–2.6
South Africa	BER (2001)	0.1–0.9
A representative African country	Ainsworth and Over (1994)	0.1–0.8
South Africa	Quattek (2000)	0.3–0.4
Botswana (a)	BIDPA (2000b)	8 (over 10 years)
Botswana	Jefferis and Greener (1999)	1–2
Trinidad and Tobago	Nicholls et al. (2000)	4.2 (over 8 years)
Jamaica	Nicholls et al. (2000)	6.4 (over 8 years)
Honduras	Cuesta (2001)	0.7–2.7
A representative sub-Saharan African country	Over (1992)	0.15–0.33
United Republic of Tanzania	Cuddington (1993a)	0.10
Malawi	Cuddington and Hancock (1994)	0.25
51 developing and industrialized countries	Bloom and Mahal (1997)	Insignificant
70–80 low- and middle-income countries	Bonnel (2000b)	1.20 (in case of prevalence of 20%) 0.80 (as in SSA, prevalence 8%)
41 African countries	Dixon et al. (2001)	1.30 (in case of prevalence of 20%)

Note: (a) National household income.

A simple model of the impact of HIV on GDP growth

This section develops a simple aggregate model, described formally in Annex 1, which tries to overcome some of the inconsistencies found in the models outlined above. The model has the following features:

i) It separates agriculture (A) and all 'other sectors' (O), such as industry, services and the public sector, that are assumed to be located only in urban areas, while excluding the possibility of migration between A and O. The different epidemiological patterns in the urban and rural sector and their shifts over time can thus be represented.

ii) It allows for two different production technologies; in agriculture, production depends on unskilled labour (U) and arable land, while in the 'other sectors' it depends upon physical capital (K), skilled labour (S) and unskilled labour.

iii) It shows 'labour surplus' for both skilled and unskilled workers, so that the death of a worker in a labour surplus area causes family impoverishment but not aggregate effects on GDP because the vacated job can immediately be filled by an unemployed worker.

iv) It computes the decline in the output of one sector (e.g. the rural sector) caused by the HIV-induced decline in purchases from it by the other (e.g. urban) sector. This means that growth rates in A and O are both supply and demand driven.

v) It allows for the emergence of public deficits incurred by governments to finance a rise in medical and social welfare expenditure. Over the medium term, such deficit is not seen as harmful to growth.

vi) It makes private saving (and therefore capital accumulation) in both A and O an inverse function of HIV prevalence.

vii) HIV reduces land and labour productivity in A and labour and capital productivity in O, while AIDS reduces the employed workforce in both A and O except in case of labour surplus.

viii) It represents the dynamics of HIV prevalence with a logistic function and that of the cumulative AIDS deaths with a similar function. Table 3 describes prevalence determined by the model at periods 0 and 3 under different assumptions about z.

The data sources used to benchmark the model are: the World Development Indicators (2001) for the GDP growth rates in 50 relevant countries; ILO (2000) for the projected labour force with and without HIV; and FAO (1999b) for the worldwide estimates of the agricultural population and labour force during the period 1950–2010. Finally, the values of the parameters used for the simulation of the model were drawn from the literature summarized in table 2.

Table 2. Sources and values of the parameters used in the model

Parameter	Value	Country, estimate and reference
l_A output elasticity of unskilled labour in agriculture in land rich and poor countries	0.3 or 0.7	Cornia et al. (1996) and Over (1992)
k_A output elasticity of the land in land rich and land poor countries	0.7 or 0.3	Cornia et al. (1996)
l_O output elasticity of unskilled labour force in the urban sector	0.3	0.3 Cornia et al. (1996) and 0.4 Over (1992)
k_O output elasticity of the productivity of capital in the 'other activities' sector	0.3	0.3 Cornia et al. (1996) and 0.2 Over (1992)
h_O output elasticity of skilled labour in the 'other activities' sector	0.4	Cornia et al. (1996) and Over (1992)
m^V_A average propensity to consume in the rural sector	0.8	World Development Indicators (2001)
m^V_O average propensity to consume in the urban sector	0.8	Cornia et al. (1996)
n_A share of consumption exp. allocated to agricultural products by the rural pop.	0.8	World Development Indicators (2001)
n_O share of consumption expenditures allocated to 'other activities' by urban pop.	0.6	Cornia et al. (1996)
% labour force in A	Not used	from 3.1 in Botswana to 92.4 in Burkina Faso World Development Indicators (2001) (a)
% GDP accounted for by A	Not used	from 2.5 in Trinidad and Tobago to 60.8 Guinea-Bissau, World Development Indicators (2001)
l^V_A impact coefficients of HIV on the productivity of unskilled rural labour	0.1	South Africa 0.08 Morris et al. (2000)
k^V_A impact coefficients of HIV on land fertility	0.1	Côte d'Ivoire 0.1 (land) Black-Michaud (1997) Uganda, United Republic of Tanzania, Zambia 0.1 (land)
		Barnett (1994) Uganda 0.06 (livestock) Haslwimmer (1994)
l^V_O impact coefficient of HIV on the productivity of unskilled urban labour	0.1	Uganda, United Republic of Tanzania, Zambia 0.02 Barnett (1994) Zambia 0 Ching'ambo (1995) South Africa 0.02–0.05 BER (2001)
k^V_O impact coefficient of HIV on the productivity of capital in 'other activities'	0	Uganda, United Republic of Tanzania, Zambia 0 Barnett (1994) Zambia 0 Ching'ambo (1995)
h^V_O impact coefficient of HIV on the productivity of skilled urban labour	0.1	South Africa 0–0.02 BER (2001)

Note: (a) In 1990, <20 Bahamas, Barbados, Botswana, Kenya, Niger, South Africa, Suriname, Trinidad and Tobago; 20–40 Belize, Dominican Republic, Guyana, Lesotho, Zimbabwe; 40–60 China, Congo, Côte d'Ivoire, Gabon, Ghana, Guatemala, Honduras, Namibia, Nigeria; 60–80 Angola, Benin, Cambodia, Cameroon, Democratic Republic of the Congo, India, Liberia, Madagascar, Myanmar, Senegal, Sierra Leone, Thailand, Togo, Zambia; >80 Burkina Faso, Burundi, Central African Republic, Chad, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Malawi, Mali, Mozambique, Rwanda, United Republic of Tanzania, Uganda.

The model is sufficiently broad to depict a good number of situations but at the same time is simple enough to be estimated on panel data. However, it is unable to capture several impacts of HIV described in the literature, such as those mediated by the erosion of social capital, the rise in the number of children orphaned by AIDS and the worsening of income distribution. Other limitations of the model concern its inability to allow for the lack of technological progress (e.g. the discovery of an HIV vaccine) or government interventions (for instance in the field of prevention and treatment) that would affect the HIV prevalence trend and cumulative AIDS deaths over time. Also, the model does not explicitly incorporate the public sector and budget deficit or the external sector (imports, exports, balance of payment, foreign aid, investment and debt).

Preliminary results

The basic scenario shows that, for any time and reasonable set of HIV prevalence, among skilled and unskilled workers in rural and urban areas, the economic impact of the cumulative AIDS deaths is greater than that of the increase in HIV prevalence. This means that the economic impact of the epidemics is somewhat 'delayed', and that in most countries affected by AIDS, the main effect of the epidemic is still to be felt (as in South Africa, chapter 4). Second, the strongest impact of AIDS deaths and HIV-related diseases occurs between the period during which HIV prevalence rises the fastest, and when it reaches its maximum. Third, once the relative importance of agriculture and of the 'other sectors' in GDP is taken into account, the growth impact estimated by the model is consistent with the results of the aggregate economy-wide models reviewed earlier. Fourth, the impact on GDP growth depends less on the relative prevalence across sectors, and more on the relative productivity of the different factors. Thus, the economic impact of HIV is greater in the urban sector as productivity is highest among the urban skilled worker, followed by urban and rural unskilled workers. Fifth, the economic impact of the epidemic is non linear, i.e. it rises more than proportionately for any increase in prevalence.

Four main measures were tested for the impact of policy interventions. The first scenario assumes that the government bears all health expenditures to prevent a reduction in the household saving rates. The second simulates a policy of accelerated training of scarce skilled workers so that their depletion rate is reduced and growth sustained. A third scenario assumes that public policy will use activities such as training to ensure that a labour surplus in one sector can fill a gap in another. The fourth scenario assumes that antiretroviral treatment is provided to workers so as to reduce the HIV impact on economic growth. The main results of the simulations can be summarized as follows:

i) Avoiding the impact of HIV on savings and capital formation by subsidizing additional expenditure on health and social welfare is the most effective policy in any scenario. In table 3, when HIV prevalence does not affect the saving rate in rural or urban areas (see column where $m^{V}_{A} = m^{V}_{O} = 0.8$), reductions in the growth rates of GDP are always consistently smaller than those when the additional HIV-related expenditures increase average consumption ($m^V_A = m^V_O = 1.0$) and reduce savings to zero. Policy decisions on the financing of additional HIV-related expenditure therefore not only have an enormous impact on the well-being of the sick, but also on national growth, especially in countries with weak or non-existent financial markets.

ii) The accelerated training of urban skilled workers is an effective policy to sustain growth only if labour productivity in agriculture is low. And accelerated training of additional rural unskilled workers (z_{US} and $z_U = 0.2$, with zr = 0.1) would lead to a smaller reduction in GDP growth (9.3-6.4 = 2.9). However, if labour productivity in the agricultural sector is high ($l_A = .7$, results not shown) – as is the case in rural Africa – increasing the supply of urban skilled workers would slow the GDP decline less than the training of rural unskilled workers.

iii) The introduction of measures promoting flexibility (by skill, gender, age and location) in the deployment of labour and facilitating substitution between different kinds of labour, reduces excess demand for the most effective and scarcest kind of labour, and so avoids large output reductions.

Table 3. Cumulative percentage reduction of the level of GDP in agriculture (A) and other activities (O) with respect to the non-HIV scenario at time 0 and 3

Prevalence among rural, urban and urban unskilled workers				$l_A = .3, k_A = .7, l_O = .3, k_O = .3, h_O = .4$			
				$m^V_A = m^V_O = 0.8$		$m^V_A = m^V_O = 1.0$	
z_R	z_U	z_{US}	t	A	O	A	O
0.0	0.0	0.0	0	0.0	0.0	47.2	47.1
0.2	0.2	0.0	0	7.3	16.3	57.0	67.1
0.1	0.1	0.1	0	4.7	18.8	53.6	70.1
0.2	0.2	0.1	0	8.3	26.9	58.4	80.0
0.0	0.2	0.2	0	3.4	35.7	51.8	90.4
0.1	0.2	0.2	0	6.4	36.3	55.8	91.4
0.2	0.2	0.2	0	9.3	37.0	59.7	92.3
0.0	0.0	0.0	3	0.0	0.0	47.2	47.1
0.2	0.2	0.0	3	12.3	32.1	66.8	91.0
0.1	0.1	0.1	3	9.8	45.9	62.7	109.7
0.2	0.2	0.1	3	15.0	60.4	70.8	130.1
0.0	0.2	0.2	3	7.5	78.0	58.5	154.6
0.1	0.2	0.2	3	13.1	79.2	67.6	156.7
0.2	0.2	0.2	3	16.9	80.0	73.8	158.2

Source: Authors' calculations.

Notes: For the explanation of l_A, k_A, l_O, k_O, h_O see table 2. The parameters z_R, z^U, z_{US} set to 0 represent a situation of surplus for rural, urban and urban skilled workers; $m^V_A = m^V_O = 0$ describes the case in which HIV prevalence does not affect the saving rates in rural and urban areas.

Policy responses

What are the possible policy responses to sustain growth and avoid distributive distortions and mass impoverishment in countries affected by HIV and AIDS? To answer this question, it is important to underline once more the fact that, unlike other shocks, such as recessions or terms of trade crises, HIV and AIDS are a long wave, not temporary phenomena, that exert a cumulative effect on the functioning of the economy. A second characteristic of HIV and AIDS is that they erode the stocks of the production factors (skilled and unskilled labour, land fertility, financial savings, investments and social capital). Finally, HIV and AIDS tend to cause considerable distributive distortions and increase poverty. Accordingly, recommendations for possible policies to sustain growth and avoid poverty in the AIDS era are outlined below:

Avoid a decline in the stock of production factors

Avoiding a decline in the stock of available labour should be a primary policy concern of HIV-affected countries. This can be achieved through prevention activities in all sectors and at all levels, as discussed in chapters 7 and 8. In view of the large costs imposed on them by HIV, firms should also be more proactive than in the past in the field of prevention, counselling, testing and treatment of STI and opportunistic infections. ARV treatment is also crucial. There are strong human rights arguments for gradually expanding such treatment to all infected people; and purely from a cost-benefit perspective, the replacement cost of many workers (for their upbringing, education and acquisition of on-the-job experience) can be much higher than the cost of generic ARV drugs.

Consequently, the health policy suggestion is that, if only a small fraction of the population can be treated, the focus should be on skilled workers, though as soon as it is possible to expand the programme, treatment should be made available to workers in different sectors, with varying skills, to avoid possible supply bottlenecks. Should the treatment of existing workers be impracticable, the training of potentially scarce skilled workers should be accelerated. Enterprises and governments should provide budgetary support to facilitate the training or importation of technicians, specialized workers and other categories of labourers in short supply. This applies to people in vital positions, entrusted, for instance, with the task of ensuring the functioning of power grids, water and railway systems, health and education, highly specialized industries and so on. Targeted interventions in some of these sectors can generate important positive effects and prevent a slowdown of growth.

In the long term, the negative impact of HIV needs to be counterbalanced by ensuring that enrolments in primary and secondary education are sustained through measures, discussed in detail in chapter 9, such as curriculum simplification, the waiver of enrolment fees, special provisions for the education and training of a mounting number of orphans, and so on.

Compensating for the decline in household savings and enterprise profits – and the ensuing drop in investments – is more problematic. Here, too, good policies can make some difference. The review of the literature in this chapter, and the model simulations presented above, suggest that state financing of a substantial part of the additional HIV-related health and welfare expenditure may limit the decline in household saving, enterprise profits and private investments. If the initial public debt/GDP ratio is low, governments can finance their HIV-related deficits by issuing state bonds. International transfer of resources – in the form of budgetary support or international investments – is also a way of sustaining capital accumulation. At the individual level, improvements in financial markets, such as making credit available at affordable rates, could help to support output among families, whether or not they are affected by HIV.

Promote greater flexibility in the use of production factors

Another possible response – at the community and enterprise level – would be to focus on measures to facilitate the mobility of production factors. There is already scattered evidence that communities affected by the virus adopt a less rigid division of labour by skill level, age and gender and encourage labour pooling arrangements, thus promoting greater flexibility in labour deployment and efficiency. This could be encouraged through incentive schemes and would help to avoid production bottlenecks.

In countries such as Botswana and South Africa, where the infection rate among skilled and unskilled workers is very high, and wages have been rising, the large mineral rents may facilitate a change towards capital-intensive rather than labour-intensive technology.

Sustain individual/community responses to preserve welfare and local economies

When faced with economic adversity, extended families and traditional societies have for long relied on well-tested and efficient informal arrangements to sustain consumption and avoid long-term economic decline. When faced with a loss of income, families generally begin by rationalizing consumption, increasing the supply of labour (with females, the elderly, or children) or migrating. The next step is to liquidate financial savings and other assets and adjust the family structure. When these measures are no longer sufficient, they revert to damaging measures such as the sale of productive assets (oxen, land, tools), the reduction of essential expenditures on health and basic food, the withdrawal of children from school and the adoption of risky behaviour (exploitative work, sex trade and crime).

For their part, communities undertake collective action (pooling labour) in production, while seeking collective economies of scale in consumption (as in the case of the Peruvian *comedores populares*, or for child care). Communities also rely on local informal insurance and assistance mechanisms. Such activities work well in short-term emergencies, but in high-HIV-prevalence countries are insufficient to avoid both a decline in well-being and shrinkage of the economic base of families and communities. There are several indications that such family and community strategies are increasingly unable to weather the economic and social impact of HIV, so they need to be scaled up with external support and complemented by other broader measures.

Employment-based programmes: HIV impoverishes not only the person infected but also – through demand, supply and systemic effects – those with links through family, employment, trade or exchange. One way of counteracting these systemic effects is to introduce employment-based programmes with the dual purpose of sustaining the incomes of the families and communities over the medium term and avoiding a deterioration of the economic base (physical infrastructure, expertise etc.) of the community.

Employment-based programmes can effectively reach the needy but able people of working age. Several arguments justify the adoption of public work schemes, which not only permit the achievement of specific poverty alleviation objectives over the short run, but also contribute to productivity growth over the long term by speeding up the accumulation of capital, or avoiding its deterioration. There is already considerable experience with the design and management of such programmes. Successful examples include the Maharastra Employment Guarantee Scheme (later replicated throughout India as the Jawahar Rozgar Yojana), Chile's Minimum Employment Programme and Occupational Scheme for Heads of Households (that in 1984 covered 40 per cent of the jobless) or Botswana's Labour-Based Relief Programme. These programmes have been successful in offsetting the impact of recessions and droughts but now need to be adjusted to the situation of HIV-affected communities, a situation in which the pandemic tends to reduce the labour power of some (but not all) segments of society.

Microcredit and training programmes: Employment-based programmes are not suitable for poor families that have no surplus labour to employ. In this case, interventions could include measures to increase the productivity and earnings of the declining amount of labour power already employed. This can be achieved through microcredit or skill-upgrading programmes. Training in activities where new skills generate quick returns (especially in the urban sector), as well as greater access to funds, enhance the ability of families and communities to respond to crises.

There is a vast literature on the design and management of such programmes, including in HIV-affected countries such as those of south-eastern Africa. Obviously, such credits create short-term liabilities and are therefore not suitable for persons with AIDS, who are likely to be sick, weak and depressed, but they should be attractive to their family members. Such microcredit is not granted for long periods – so HIV-positive people unaware of their status may participate in such community-based schemes that often combine welfare and economic support into one single intervention (chapter 8).

Income transfer: Such programmes not only avoid unnecessary suffering, but also prevent the adoption of destructive survival strategies, such as the sale of productive assets and the withdrawal of children from school. Such measures are necessary for those families that cannot be helped through employment-based, microcredit or training programmes.

Insurance or assistance-based transfer programmes have been in existence in low- and middle-income countries for some years, but are generally underdeveloped in the countries affected by HIV. The standard Western model of social security is of little applicability to low-income HIV-affected countries for cost and organizational reasons. Yet, there are examples in low-income rural settings of low-cost, non-contributory, state-funded schemes, providing coverage in old age, sickness, disability, widowhood and situations that cannot be tackled by increasing access to employment. The Kerala and Tamil Nadu non-contributory old age pension schemes, for instance, cover almost all the elderly poor, while some form of social assistance is available to the physically handicapped, the victims of work injury and half the workers in the informal sector. An estimated 17 per cent of poor households in Tamil Nadu are covered by this programme, and nearly 60 per cent of the beneficiaries are poor women. It is estimated that the extension of such a minimum social assistance package to all similar poor households in India would cost only 0.3 per cent of the national GDP (Guhan 1992).

Income transfers can be targeted directly or indirectly to HIV-affected children, through orphan and/or foster care allowances, basic pensions for the elderly – who are often in charge of a number of orphans – as well as to impoverished people sick with HIV. Such transfers can be in kind (food/clothing), in cash (books/school meals/transport allowances) and exemptions from school and medical fees. Elements of such schemes are in existence in several HIV-affected countries. In Botswana, in 2000, the Government introduced a monthly ‘package’ of $60-worth of subsidies in kind for children orphaned by AIDS. South Africa has instituted a child support grant, a foster care allowance and a care dependency grant for children with severe problems (chapter 4). Thailand has developed a mixed system in which temple-based and community-based transfers are complemented by central government interventions targeted at children (chapter 5). Even financially stretched countries such as Zambia have considered a modest transfer system (worth $0.5 million a year) to offset school costs for children orphaned by AIDS (personal communication of UNICEF Zambia). These programmes should be expanded, better analysed and evaluated. Particular attention needs to be placed on key design issues, such as the value of the transfer, the target population (whether all children in HIV-affected families, children orphaned by AIDS, or all orphans), the disbursement channels (the municipal and local authorities, the NGOs or the communities) the institutional arrangements, and other considerations, including accountability and potential problems of stigma for beneficiaries.

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Annex 1

Model structure

In the absence of policy measures to control it, the dynamics of HIV prevalence can be depicted by a non-linear function that can be meaningfully assumed to be a logistic function. The AIDS death rate *D(t)* rises with a time lag of one period (of seven years) in relation to the HIV prevalence *V(t)*:

$$V(t) = \frac{e^{t}}{1+e^{t}} \qquad D(t) = \frac{e^{t-1}}{1+e^{t-1}}$$

The model assumes that HIV epidemiological patterns are likely to vary in different areas of the country and therefore introduces a distinction between HIV prevalence in rural and urban areas. For sake of simplicity, the model assumes that, for each time *t*, the impact of HIV-related diseases and AIDS deaths in rural areas is a proportion of those in urban areas. Let z_R and z_U be the parameters attached to *V(t)* and *D(t)* to represent the HIV and AIDS dynamics in rural and urban areas, respectively:

$$V_R(t) = z_R \frac{e^{t}}{1+e^{t}} \quad D_R(t) = z_R \frac{e^{t-1}}{1+e^{t-1}} \quad V_U(t) = z_U \frac{e^{t}}{1+e^{t}} \quad D_U(t) = z_U \frac{e^{t-1}}{1+e^{t-1}}$$

The impact of HIV-related diseases and AIDS deaths on the economy is likely to be different in different sectors, so that their aggregate impact depends on the relative importance of these two sectors in the country considered. In this model, the rural economy is devoted only to the production of agricultural goods and the urban economy is involved only in the production of all 'other sectors' so that the labour force in agriculture and the 'other sectors' is taken to be the rural and urban active population.

The impact of HIV-related diseases and AIDS deaths is also likely to differ according to the skill level of the labour force. To make things easier, the model assumes that in each time period *t* the impact of HIV-related diseases and AIDS deaths on skilled workers is a multiple z_{RS} and z_{US} of that on the unskilled workers where the subscripts $_{RS}$ and $_{US}$ refer to rural skilled and urban skilled workers. As a result, the impact of HIV and AIDS on skilled and unskilled workers in the urban and rural sector can be written as follows:

$$V_{RS}(t) = z_{RS} \frac{e^{t}}{1+e^{t}} \quad D_{RS}(t) = z_{RS} \frac{e^{t-1}}{1+e^{t-1}} \quad V_{US}(t) = z_{US} \frac{e^{t}}{1+e^{t}} \quad D_{US}(t) = z_{US} \frac{e^{t-1}}{1+e^{t-1}}$$

The growth process is depicted using two generalized Cobb–Douglas production functions, one for the rural and one for the urban sector. In agriculture, growth depends on the availability of unskilled labour and land, while in the 'other sectors' it depends on skilled and unskilled workers and the capital stock. Let L_A, K_A, L_O, K_O and H_O be the amount of unskilled workers, land, physical capital and skilled workers respectively involved in agriculture and the 'other sectors' and l_A, k_A, l_O, k_O and h_O be their coefficients in the relevant production functions.

As for the impact of the pandemic on production, the model assumes that the HIV-related diseases reduce the productivity of unskilled workers, land, capital and skilled workers. Let $l^V{}_A$, $k^V{}_A$, $l^V{}_O$, $k^V{}_O$, $h^V{}_O$ be the coefficients through which the spread of HIV affects the productivity of these factors of production. For simplicity, we assume that the productivity of capital in the 'other sectors' declines in line with the spread of HIV among the skilled workers only. Thus, the level of GDP in the agricultural and 'other sectors' is given by:

$$Y_A = L_A^{l_A} K_A^{k_A} (I_R L_A)^{\text{[illegible]}} (I_R K_A)^{\text{[illegible]}}$$

$$Y_O = L_O^{l_O} K_O^{k_O} H_O^{h_O} (I_U L_O)^{\text{[illegible]}} (I_{US} K_O)^{\text{[illegible]}} (I_{US} H_O)^{\text{[illegible]}}$$

The impact of AIDS deaths on production is to reduce the amount of unskilled and skilled workers. As the model does not contemplate the possibility of migration between sectors, the impact of AIDS mortality on agriculture and the 'other sectors' is given by:

$$\dot{L}_A(t) = -z_R D(t) L_A(t)$$

and

$$\dot{L}_O(t) = -z_U D(t) L_O(t)$$

where these two relations depict the reduction in the number of workers available in agriculture and the 'other sectors', while

$$\dot{H}_O(t) = -z_{US} D(t) H_O(t)$$

represent the reduction in human capital due to the death of experienced staff in the 'other sectors'. Notice that setting z_R , z_U and z_{US} equal to 0 allows to simulate a situation of labour surplus for both skilled and unskilled workers. As for capital accumulation, the model assumes that there are no foreign investments and that capital formation in both agriculture and the 'other sectors' depends only on the savings generated within each of these two sectors. Let m_A and m_O be the average shares of GDP devoted to private consumption in rural and urban areas. HIV-related diseases increase such propensities to consume. Let $1\text{-}m^A$ and $1\text{-}m_O$ be the saving rates in rural and urban areas, and let $m^V{}_A$ and $m^V{}_O$ be the coefficients through which the HIV dynamics affect these saving rates. The model assumes that the saving rate in urban areas depends on HIV prevalence among unskilled workers. Thus the changes in capital stock in agriculture and the 'other sectors' are given by:

$$\dot{K}_A(t) = Y_A(t) - m_A Y_A(t) - m_A m_A^H V_A(t) Y_A(t) - d_A K_A(t)$$

$$\dot{K}_O(t) = Y_O(t) - m_O Y_O(t) - m_O m_O^H V_O(t) Y_O(t) - d_O K_O(t)$$

Assuming that $d_A = d_O = 0$ allows to solve explicitly for:

$$L_A(t, L_A(0), z_R) \quad K_A(t, K_A(0), V_A(t), m_A, m_A^H)$$

$$L_O(t, L_O(0), z_U) \quad K_O(t, K_O(0), V_O(t), m_O, m_O^H) \quad H_O(t, H_O(0), z_H)$$

Assuming then that $L_A(0) = L_O(0) = H_O(0) = 1$ (i.e. standardizing the initial values of these variables to 1), the changes in GDP in agriculture and the 'other sectors' can thus be written as the log transformation of the GDP levels. Therefore, the HIV and AIDS impact on the change of GDP in these two sectors is given by:

$$\hat{Y}_A(t) = l_A(1 - l_A^H V_R(t)) \hat{L}_A(t) + k_A(1 - k_A^H V_R(t)) \hat{K}_A(t) - (l_A l_A^H + k_A k_A^H) V_R(t) \hat{V}_R(t)$$

$$\hat{Y}_O(t) = l_O(1 - l_O^H V_U(t)) \hat{L}_O(t) + k_O(1 - k_O^H V_U(t)) \hat{K}_O(t) + h_O(1 - h_O^H V_{UX}(t)) \hat{H}_O(t) -$$

$$l_O l_O^H V_U(t) \hat{V}_U(t) - (k_O k_O^H + h_O h_O^H) V_{UX}(t) \hat{V}_{UX}(t)$$

This allows to obtain explicit solutions for:

$$Y_A(t, Y_A(0), m_A, m_A^H, L_A(0), z_R, l_A, l_A^H, K_A(0), k_A, k_A^H)$$

$$Y_O(t, Y_O(0), m_O, m_O^H, L_O(0), z_U, l_O, l_O^H, H_O(0), z_H, h_O, h_O^H, K_O(0), k_O, k_O^H)$$

in which the world demand for, and prices of, national products and the net capital inflows remain unchanged. Finally, the model defines

$$g_A(t) = \dot{Y}_A / Y_A \quad g_O(t) = \dot{Y}_O / Y_O$$

as the growth rates of output in agriculture and the 'other sectors'. Finally, let us assume that $Y_A(0) = Y_O(0) = 1$ and that n_A and n_O are the proportions of consumption expenditures allocated to agricultural products by the rural population and to other products by the urban population. This allows to take into account the negative impact on the growth of each of the two sectors of the decline in the demand originating in the other sector. Thus, the supply and demand impact of HIV and AIDS on growth rates of the sectoral GDP is given by:

$$g_A^D(t) = (1 + m_A n_A) g_A(t) + [m_O(1 - n_O)] g_O(t)$$

$$g_O^D(t) = (1 + m_O n_O) g_O(t) + [m_A(1 - n_A)] g_A(t)$$