

Draft: 12/22/02
Revised: 2/10/03

Macroeconomic Models of the Impact of HIV/AIDS

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Introduction

Major differences of opinion are emerging in assessments of the socio-economic impact of HIV/AIDS in heavily affected countries between the experiences of those who are devising practical responses to the pandemic, and forecasts based on macroeconomic modeling.

At the recent World Economic Forum in Davos, for example, Dr. Richard Feachem, Executive Director of the Global Fund to Fight AIDS, TB and Malaria, described the effects of AIDS as “worse than anything we have seen since the Black Death.” Dr. Gordon Conway, President of The Rockefeller Foundation, stated that “nothing in recorded history” matches the devastation that has only just begun.

Yet, many economists working on Africa predict that the economic consequences of AIDS over the coming decade will be relatively modest. For example, in South Africa, where the HIV prevalence rate exceeds 20 percent, the expected reduction in economic growth is from a hypothetical 4 percent per annum without AIDS to 3.2 percent with AIDS. This is not a trivial change, but it could easily be produced by other factors that also affect growth – revenue shocks, falling commodity prices, drought, and civil unrest – to mention but a few.

In this note, I discuss the key features of the macroeconomic models, what their results show, and why projected growth reductions are relatively limited. I then suggest a number of reasons why these models may be systematically understating the economic impacts of HIV/AIDS.

Macroeconomic Models

A macroeconomic model provides a statistical description of an economy. It comprises a set of technical and behavioral equations and accounting identities that describe: how production is organized; the behavior of individuals, businesses, and governments; and how the major economic variables add up. When combined with projections of variables determined outside the model – such as weather patterns, average rainfall, tourist arrivals, petroleum prices, foreign aid flows, demographic trends, and so on – a macroeconomic model yields projections of GDP, employment, and other

variables that are closely watched by policymakers and others interested in the economy's performance.

The value of any projections depends, of course, on how realistic the assumptions are regarding the various trends. Demographic projections are critical elements in analyzing the impact of HIV/AIDS, especially the date at which HIV prevalence is expected to peak. Other crucial assumptions relate to the expected effects of HIV/AIDS on labor productivity, savings and investment rates, and changing patterns of government and business expenditures.

None of this is rocket science and all modeling exercises have large errors. Constructing a model involves errors of specification, measurement, and estimation. Deriving time paths for variables that are determined outside the model involves prediction errors. Finally, shocks of some form (financial disruptions, floods, civil unrest) may occur to compound these errors.

Despite such shortcomings, macro models are useful for at least three reasons. First, the mere act of formulating, estimating, and interpreting the model imposes discipline on economic analysts and policymakers. Second, the exercise offers a systematic opportunity for learning about the economy in ways that dispel wishful thinking and challenge prejudice. Third, all macro economic aggregates represent the cumulative outcomes of economic decisions taken by the micro units in the economy – individuals, households, businesses, and organizations (including government). The modeling exercise forces analysts to ensure that the macro outcomes they are seeking to understand are consistent with the known, underlying, micro behavior.

Macroeconomic Models of the Impact of HIV/AIDS

A number of models of the economy-wide impact of HIV/AIDS in Africa were published in the early 1990s². Based on data from Cameroon, Tanzania, and Malawi, these models showed that HIV/AIDS would have only a minor effect on macroeconomic performance. At the time, HIV prevalence rates were relatively low and few people had developed AIDS.

A similar small effect was reported in the World Bank's study *Confronting AIDS, Public Priorities in a Global Epidemic*. Published in 1999, this study determined that for the 10 African countries with the highest HIV prevalence rates, the decline in the annual average growth of GDP per capita as far out as 2025 would be around 0.3 percent. (The expected growth 'without AIDS' was on the order of 3.5 percent.) This result was largely driven by the assumption that the group most seriously affected by HIV/AIDS would be workers with the fewest skills. The loss of large numbers of relatively unproductive workers was not seen as a major threat to productive capacity.

A new generation of models has paid more attention to the changes in both population and labor supply.³ This is consistent with the continued intensification of the epidemic. Earlier expectations that the epidemic would peak during the 1990s obviously

were premature. Indeed, over the last two years, many AIDS specialists have asserted that the “epidemic is still in its early stages.”⁴

Consistent with our increasing knowledge of the effects of HIV/AIDS, these new generation models incorporate a broader range of retrogressive effects than earlier models. Specifically, they have allowed for reductions in human capital, declining savings and investment rates, disintegrating households, increasing poverty, falling labor productivity, and impaired institutions. But, even with these additions, the models suggest that the aggregate economic impact of HIV/AIDS will remain modest.

To illustrate, three different models dealing with South Africa show that the cumulative loss of GDP by 2010 will range from 4 percent to slightly above 8 percent. This implies a reduction in the growth of GDP of between 0.4 and 0.9 percent per annum. For Botswana, the reduction in GDP growth until 2015 is expected to be just over 1 percent per annum – from 3.9 percent (without AIDS) to 2.8 percent (with AIDS). Similarly, a study of Mozambique estimated that HIV/AIDS would reduce the annual growth of per capita income over the coming decade by between 0.3 and 1 percent. (Per capita income ‘without AIDS’ was expected to be above 3 percent.) In Malawi, the estimated cumulative loss of GDP by 2010 due to HIV/AIDS was projected to be around 10 percent. Finally, a study based on data for more than 70 developing countries derived a relationship between the HIV prevalence rate and the decline in the annual growth of GDP. That relationship shows an average loss of GDP growth of 0.4 percent per annum at a HIV prevalence rate of 5 percent increasing to a loss of 1.4 percent per annum at a prevalence rate of 30 percent. In sum, even the recent, more detailed macroeconomic models forecast a relatively modest impact of AIDS on economic growth.

Potential Explanations

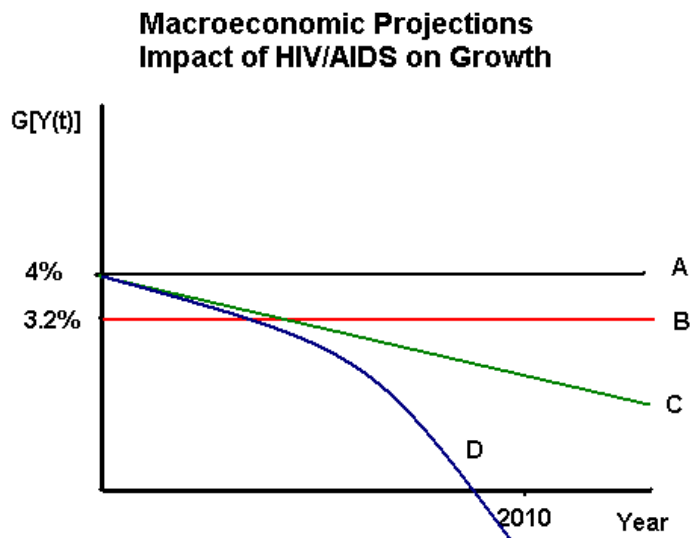
These examples could be multiplied. Estimates from a wide range of countries reveal that none of the projected effects of HIV/AIDS on economic growth is large, certainly not large enough to produce a devastating collapse of income. Why is this the case?

There are several reasons why the reduction in growth rates may be low. First, there is considerable evidence supporting the position of the World Bank’s *Confronting AIDS* study that the heaviest loss of labor in Africa, up to this point, has indeed been amongst the least productive workers. Because of high unemployment (and, in the case of Botswana, immigration), these workers have been easy to replace. Second, the long lead time between HIV infection and the onset of AIDS has meant that no African country has yet experienced the large and growing losses of population and work force that are in store.⁵ For Malawi and Zambia, AIDS losses will begin to accelerate in 2004 and 2005. Current experience provides no basis for modeling these effects. Third, none of the macro models has incorporated serious disruptions in agricultural production and food security, a factor that the recent drought in Southern Africa is bringing to the fore.⁶

Fourth, all models assume an early peak in the epidemic. In South Africa, for example, HIV prevalence is projected to peak in 2006 at 26 percent of the adult

population. This assumption automatically limits the extent to which projected output can fall.⁷ Finally, none of the models has adequately allowed for the erosion of networks and information channels that are fundamental to labor specialization and the maintenance of social capital.⁸ Recent research has highlighted the critical importance of information networks for the generation and maintenance of rapid economic growth. Silicon Valley and Route 128 (for high tech), Bangalore (for software and IT services), Singapore (for component assembly and trans-shipment), and London and New York (for finance) are some of the most obvious network hubs. HIV/AIDS undercuts economic networks by stripping them of the skills and organizational talent that foster and maintain them.⁹

Are these projection models providing analysts and policymakers with a false sense of security? My research suggests that significantly larger economic losses will occur and that countries will find it increasingly difficult (when measured in terms of finance, skills, time, and effort) for their economies and societies to recover. The situation is depicted graphically in the figure below.



$G[Y(t)]$ = GROWTH OF AGGREGATE INCOME.

- A – This is the rate assumed for South Africa without AIDS.
- B - Consistent with results in ING BARINGS (2000); ABT ASSOCIATES (2000); ARNDT AND LEWIS (2000); and BER (2001).
- C - Consistent with BONNEL (2000) which shows that the decline in the growth rate tapers off as the HIV prevalence rate increases from 5 to 30 percent.
- D - Occurs when retrogressive effects cumulate.

Current projection models suggest the relatively mild impacts (A, B, C) on economic growth. A less optimistic trend (D) is becoming increasingly likely. What evidence supports this view?

- So far, no country has yet had to deal with the full flush of AIDS cases consistent with HIV prevalence rates of 20 percent or higher. There is no precedent for such large losses of population and work force. However, the experience of ‘failed states’ points to the type of devastating social disruptions that may occur. Most African countries were performing poorly even before HIV/AIDS began to spread, largely due to their government’s start-stop approach to economic reform. With the HIV/AIDS epidemic now at full force, these countries can only begin counteracting the effects of the epidemic if they undertake far more dramatic restructuring than they were prepared to previously. It is unlikely that such a broad shift in strategy will occur, especially in countries so reluctant to reform such as Zambia, Zimbabwe, South Africa, Ethiopia, and Nigeria. Yet, even if these and other African countries were to make the necessary adjustments, HIV/AIDS has already seriously eroded the domestic capacity (human, institutional, organizational, and financial) they need to respond effectively.
- As debility and death from AIDS increases, the productive capacity of many African economies will begin to implode. So far, analysts and policymakers have paid too little attention to the consequences of the cumulative loss of productive capacity as sales, distribution, and information networks unravel, and the knowledge, experience, and capacities to learn and adapt disappear. (Indeed, in some countries, such as Zimbabwe and Zambia, the unraveling is underway.)
- As noted briefly above, food security has worsened dramatically in a number of African countries. Unlike previous famines in which the weaker members of society (the very young and very old) were vulnerable, high HIV prevalence countries are having their agricultural production systems hollowed out through the loss of adult workers. This jeopardizes the recovery of the agricultural sector and threatens the ability to maintain food security.
- The resources provided by the Global Fund and pledges by the World Bank to ‘scale up’ external support to deal with HIV/AIDS are unlikely to make a significant difference over the next several years. The increase in resources announced by President Bush in his State of the Union speech will help but even these will take time to come on stream. With virtually no exceptions, the development agendas of African governments already grossly overextend their existing capacities. As a result, no ‘scaling up’ of the HIV/AIDS effort is possible unless and until serious decisions are taken about the activities that have to be ‘scaled down.’ Despite years of adjustment and reform, and more recently within the context of the IMF-sponsored Poverty Reduction Strategy Programs, these decisions have not yet been taken.

The practical impact of the declining growth rates described above is illustrated by the institutional crises highlighted below.

Examples of Non-Linear Effects of HIV/AIDS across Africa

- In Malawi, current estimates indicate that up to 25 percent of the civil service will die by 2005.
- In Zambia, school teachers have been dying at a rate that exceeds the annual capacity of the teacher training colleges.
- By 2010, in KwaZulu-Natal approximately 68,000 of the present 75,000 school teachers will be lost from the system (due to AIDS and employment poaching).
- In Kenya, approximately 75 percent of the deaths in the police force can be traced to AIDS.
- The Northern Province of Zambia produced more than 1.2 million 90 kilogram bags of maize over a decade ago. Recent production has been 350 thousand bags. Relatively free of drought, this area has seen its basic agricultural system undermined by the spread of HIV/AIDS.
- In Malawi, more than 40 percent of the positions in most departments of the Ministry of Agriculture are vacant. A similar pattern can be found in other ministries.

Conclusion

Projections of the economic impact of HIV/AIDS derived from macro models show that the epidemic will not dramatically reduce income growth. This note has examined how this outcome was derived and suggests that it may be overly optimistic. The HIV/AIDS epidemic has continued to intensify. This casts doubt on the validity of the trends assumed in the models for labor productivity, demographic shifts, and dates when HIV prevalence will peak.

Perhaps the most significant reason to doubt the assumptions, however, is that so far no African country has experienced the full weight of the debility and death from AIDS that is moving through the system. For some countries, this is likely to occur in 2004 and 2005. At that time, income growth is likely to decline sharply due to the loss of human capital and the erosion of critical institutions and economic networks.

This scenario would be accompanied by a major collapse of investment. All relevant economic actors – individuals, businesses, and governments – facing a future of declining income would have no incentive to invest even if they had the resources. Such a development would make the decline in income self-reinforcing.

The challenge for all interested parties will be how to break out of this downward spiral. What role should businesses take in spurring investment? How can businesses work with government to maintain (and even enhance) public sector capacity? What are the rules of the game by which business and government would cooperate to maintain (and even boost) economic growth? Could additional foreign assistance be used effectively to prevent investment and income from collapsing? Questions like these and

others will be difficult to answer but represent the necessary next steps in this ongoing discussion.

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Endnotes

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- ¹ I am grateful to Professor John Ruggie and Michael MacIntyre for their helpful comments.
- ² Kambou, Devarajan and Over 1992; Cuddington 1993; Ainsworth and Over 1994; Cuddington and Hancock 1994; Brown 1996
- ³ Bonnel 2000, ING Barings 2000; Arndt and Lewis 2000, 2001; BER 2001; MacFarlan and Sgherri 2001; Harvey 2001; Haacker 2001; NES 2001; Arndt 2002
- ⁴ Nullis 2000; Abt Associates 2000; BBC News 2002, 2002a; Barnett and Whiteside 2002
- ⁵ Barnett and Whiteside 2002, Ch. 2, esp. p.48
- ⁶ Winfield 2002; de Waal and Whiteside 2003
- ⁷ Modeling exercises typically link output to the labor force. In the projection exercises, output will only fall as long as the labor supply continues to fall. In the demographic models, that occurs just after the HIV prevalence peaks.
- ⁸ Kremer 1993; Acemoglu 1996; Johnson 2000; Ramcharan 2002
- ⁹ A key feature of the generation and use of information (and knowledge) is that its impact is multiplied when it is shared (Hayek 1945; Arrow 2000). The process works in reverse as well when information is not shared. Thus, the loss of critical staff, organizational disruptions, and institutional impairment associated with the spread of HIV/AIDS sharply reduces economic efficiency (or productivity) and places serious pressures on the whole social structure.