HIV/AIDS: DOES IT INCREASE OR DECREASE GROWTH IN AFRICA?[1]

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November 6, 2000

Abstract

Infectious diseases matter greatly for Africa. Cross-country regressions for the 1990-97 period suggest that HIV/AIDS has reduced the rate of growth of Africa's per capita income by 0.7 percentage points per year. For those African countries affected by malaria, growth was further lowered by 0.3 percentage points per year. Such reduction is large when compared with the historical growth of 0.4% achieved in 1990-97. Various factors related to poverty, inequality, gender inequality, labor mobility and ethnic fractionalization have facilitated the rapid spread of HIV. But what has enabled HIV/AIDS to undermine economic and social development is the erosion of some of the main determinants of economic growth such as social capital, domestic savings and human capital. Through such channels the HIV epidemic was transformed from a health issue into an economic disease that impairs economic and social development. Because it prevents an increasing share of the population from participating in economic growth, the HIV/AIDS epidemic increases poverty. The result is a vicious circle whereby HIV/AIDS reduces economic growth and increases poverty, which in turn accelerates the spread of HIV. Without strong and immediate action, it will prove quite difficult to overcome the cost of inaction latter on.

[1] The results included in this paper should be viewed as preliminary. The opinions expressed here do not necessarily reflect those of the World Bank.

Introduction

In the early model of Malthus, the relationship between population growth and per capita income was negative. Population decline in the context of a fixed amount of land and technology was projected to increase income per capita. This Malthusian framework described quite well the evolution of per capita income for most of human history. For example, Europe's Black Plague, which resulted in a smaller population, led to higher real wages.[2]

The conclusion that lower population growth could increase income per capita underlied the early economic analysis of HIV/AIDS[3]. There was a general agreement that HIV/AIDS would generate a substantial fall in output, but the impact on per capita income was viewed as indeterminate ex ante due to two opposite factors. On one hand, lower labor force growth due to AIDS-related mortality would increase per capita income[4]. On the other hand, reduction in the stock of capital would lower per capita income. This was most likely to occur if the medical costs entailed by HIV/AIDS were mainly financed by reducing domestic savings rather than consumption and if the country did not increase its external financing. In such circumstances, the resulting fall in domestic savings would translate into lower investment and per capita income.

Whether per capita income would increase or decrease was therefore an empirical question. In most cases, a lower rather than higher per capita income was judged to be the most realistic outcome, but the overall reduction in growth rates was quite modest of the order of 0.1 to 0.3 percent per year.[5] In some cases such as Botswana, per capita income was projected to increase as a result of HIV/AIDS mainly because AIDS was projected to affect labor force growth more than national saving, but Botswana's situation is clearly unusual. [6] For most developing countries, the available evidence suggested that AIDS has had an insignificant effect on the growth rate of per capita income with no evidence of reverse causality from growth to AIDS (Bloom, 1997).

Compared to other high-priority policy interventions such as reducing poverty and/or maintaining macroeconomic stability, the small or negligible growth impact of HIV/AIDS seemed to justify the policy of benign neglect that characterized most developing countries in the 1990s.

What we now see is a major development crisis. Not since the Black Death devastated medieval Europe has humankind observed infectious disease deaths on such a scale. HIV/AIDS has become one of the worst killers among infectious diseases. Worldwide,

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[2] For an analysis of population growth and per capita income, see Galor and Weil (1999).

[3] For example see Cuddington (1993). Another approach consisted of estimating a CGE model and projecting the sectoral effects of a reduction in the labor force (Kambou, Devarajan and Over, 1992).

[4] To increase the model's realism, other considerations were introduced that would lower economic growth. These included the extent to which the labor force affected by AIDS was highly skilled or the extent to which the productivity of the labor force would be reduced due to HIV/AIDS (see Over, 1994).

[5] See Ainsworth, Martha and Over, Mead. 1994. "Aids and African Development".

[6] Most of Botswana's income comes from diamonds exports which are unlikely to be adversely affected by HIV/AIDS. In addition, due to Botswana's excellent international credit rating, any shortfall in domestic saving could easily be offset by borrowing from abroad with the result that the stock of capital would not fall.

some 22.2 million people have died since the beginning of the HIV/AIDS epidemic (UNAIDS 2000). In Africa, AIDS-related diseases are the main cause of mortality. Life expectancies, which rose steadily before the onset of the HIV epidemic, are decreasing in nearly all the countries where the HIV epidemic is spreading. In the high HIV prevalence countries, life expectancy is projected to fall to about 30 years – a level not seen since the beginning of the 20th century.

HIV/AIDS' extraordinary impact on development is due to its ability to undermine three main determinants of economic growth, namely physical, human and social capital. The following factors explain why HIV/AIDS is affecting the economic and social development to such an extent.

- *The speed and scale of the epidemic has been much worse than projected*. Compared to what was projected in the early 1990s the scope of the epidemic was certainly unexpected.[7]
- *HIV/AIDS reduces the stock of human and physical capital*, because it affects primarily the adult population in its most productive years, and it undermines its incentives to save and invest**.** The result is that the first-round reduction in human capital caused by AIDS-related deaths is further amplified over time by reduced incentives to invest in human capital.
- *AIDS destroys social capital because it is tearing away at existing institutions***.** At the local level, AIDS is destroying the social fabric of communities. At the national level, AIDS is undermining the capacity of governments to provide basic social services and efficient economic management, regulation and legal framework. The main economic effect is to reduce the efficiency of production and to lower output. This effect is probably recent, but it is likely to become more important over time.
- *Feedback effects further amplify the impact of HIV/AIDS on economic growth***.** If left unchecked, the HIV epidemic undermines some of the main determinants of growth, which in turn facilitates the spread of the HIV epidemic and further magnifies the initial impact of HIV on economic growth.

As a consequence of the long incubation period of the HIV virus (7-10 years), the impact of the HIV/AIDS epidemic is drawn over time with the rate of growth of physical and human capital falling down gradually, and the efficiency of social capital declining slowly. Over time, the behavior of GDP would reflect a similar gradual downward adjustment showing up as a reduction in the rate of growth of GDP rather than a sudden fall in GDP per capita. While it takes time for these effects to appear, their cumulative impact over time has now become apparent and underlies the cross-country evidence discussed in this paper.

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[7] For example, the number of new HIV infections turned out to be twice as large as projected under a worst case scenario in 1993. The number of new HIV infections in Africa was projected to remain at 1 million (base case) and to reach 2 million by 2000 under a worst case scenario ("Investing in Health" World Development Report 1993, p.101; World Bank). However, new infections reached 4 million in Africa in 1999 (UNAIDS, 1999).

Methodological Approach

The first hypothesis is that HIV/AIDS reduces the growth rate of per capita income because: (i) it leads to a fall in the growth rate of labor and capital; and (ii) it generates a downward shift in the overall production function due to the erosion of institutions and policies that are crucial for economic growth.[8] The second hypothesis is that the impact of the HIV epidemic on growth has been amplified by the feedback effects that occur as part of the process of development.

The paper is organized as follows. The first section discusses the main channels through which HIV/AIDS affects economic growth. The second section reviews the main economic and social determinants of HIV/AIDS. The econometric model is presented in the third section along with the empirical results.

I - From HIV/AIDS to Economic and Social Stagnation

Macroeconomic policy. Sound fiscal, monetary and exchange rate policies have consistently been found to be extremely important for growth. The hypothesis is that HIV/AIDS adversely affects macroeconomic outcomes because it worsens fiscal deficits and reduces the macroeconomic management capacity of governments. As shown in Table 2 (Annex), the available econometric evidence suggests that macroeconomic outcomes –as measured by the World Bank ratings of macroeconomic performance of developing countries— were negatively affected by the HIV/AIDS epidemic in 1998.

Physical capital. Initially, the HIV/AIDS epidemic has a negligible impact on physical investment. Over time investment would be affected to the extent the HIV epidemic worsens the government budget and reduces domestic savings.

The fiscal deficit is likely to worsen because of increased expenditures. Health expenditures would rise on account of the treatment and care of AIDS-related diseases. Other government expenditures would also increase because of pension payments for the AIDS-related deaths of civil servants. Newly hired civil servants would have to be trained, which is costly in the case of teachers and health professionals. In most cases, the fiscal deficit would worsen because few countries can offset the fiscal cost of the HIV/AIDS epidemic by cutting other expenditures or raising taxes. The reason is that the HIV epidemic is often the most advanced in those economies that are already in a weak economic condition and least able to adjust expenditures and revenues.

The savings of households could either increase or decrease. Faced with the illness of adult family members, households experience a fall in income, which forces them to deplete their savings and/or assets. So far, this seems to have been the predominant development. In the case of a well-established HIV epidemic, however, savings could increase. If the risk of contracting AIDS-related diseases is viewed as significant, households would increase their savings to cover the cost of medical expenditures latter

[8] The importance of policy incentives for economic growth is analyzed in recent papers, which show that economic growth cannot be adequately accounted for simply by factor accumulation. Policy incentives are what matters because they affect the accumulation of physical and human capital. See for example, Easterly (2000).

on in life. Savings would also rise if HIV/AIDS leads to higher per capita income. This could occur especially for skilled labor. Provided that skilled labor is in short supply, AIDS-related death could lead to an increase in the wages of skilled labor. But this is unlikely to be the case for unskilled labor given the usually large pool of unemployed workers and potential migrant workers from rural areas.

Whether savings increase or decrease is therefore ambiguous. On balance, the empirical evidence suggests that savings fell. As shown by Table 1, the change in the domestic saving rate of developing countries from 1990 to 1996 was negatively related to the level of the HIV prevalence rate. Because domestic saving is the main source of financing for most developing countries, the reduction in savings would lead to less domestic investment, which in turn would reduce long-term economic growth.

The decline in growth could be avoided if the increased expenditures are financed by external financing. In such a case, domestic investment would be maintained. So far, this outcome did not materialize because the external assistance mobilized by developing countries for HIV/AIDS during the 1990s has been extremely small (UNAIDS, 1997).

Human capital. Unlike for physical capital, the impact of HIV/AIDS on human capital could be more pronounced in the initial stages of the HIV epidemic than over the long-term. The initial effect of HIV/AIDS is to destroy human capital. This effect has been particularly strong because in the absence of adequate information on HIV/AIDS in the early 1980s, both high and low-income groups were infected. As a result, a generation of educated civil servants, teachers, health workers and professionals is being lost. But as information on the HIV epidemic is more widespread, and because skilled workers have greater incentives to invest in prevention activities, one would expect that educated workers would become relatively less infected over time.[9]

Another factor contributing to reducing the initial impact of HIV/AIDS on human capital is the evolution of wages. To the extent that the wages of skilled labor rise relative to those of unskilled labor, the return to schooling would increase. This would be especially relevant for the youth who are not yet HIV positive. The increased return would also strengthen their incentives to invest in HIV prevention interventions.

These two factors are consistent with the recent changes in behavior, which have been mainly concentrated among the young age groups. For example, both in Zambia and Uganda, recent surveys have documented a substantial fall in the HIV prevalence rate among the 15-19 age group as a result of a postponement of the first sexual activities (UNAIDS, 2000).

[9] Better educated workers have more incentives to invest in HIV prevention methods than less educated workers because the cost of HIV/AIDS infection rises with education and training. This cost is proportional to the earnings lost due to AIDS-related mortality.

Table 1: Education, Domestic Saving and HIV Prevalence Rate 1/

	Dependent Variables	
	Change in secondary enrollment rate (1990-95)	*Change in domestic saving rate (1990-96)*
Constant	-6.73	0.46
	(-1.2)	(0.1)
Gross domestic saving rate (1990)	--	-0.28**
		(-2.8)
Secondary enrollment rate (1990)	-0.11*	-0.10**
	(-1.6)	(-2.02)
Growth rate of GDP per capita (1980-90)	124.3**	86.6**
	(3.54)	(2.4)
Number of phones per capita (in log) 2/	5.06**	2.49*
	(2.1)	(1.8)
Log of HIV prevalence rate (1997)	-0.39	-1.18
	(-0.62)	(-1.5)
Log of HIV prevalence rate, squared	-0.49**	-0.61**
	(-2.6)	(-2.6)
Dummy variable for Southern Africa	11.2**	10.2**
	(2.8)	(2.2)
R^2	0.40	0.38
Adjusted R^2	0.33	0.32
No of countries	64	77

Notes:

1/ Cross-country regression. Heteroscedasticity-consistent t statistics in parentheses (White correction). ** indicates that the coefficient is statistically significant at the 5% level; * indicates statistical significance at a 10% level.

2/ Number of phones per person is used as an index of development. Regression with the log of GDP per capita generated the same result.

By contrast, the HIV epidemic would have a different impact on the adult population. In the absence of an effective cure for AIDS, workers who are already HIV positive would face lower incentives to invest in additional training because the increased salary resulting from training would be recovered over a shorter time horizon. In addition, HIV/AIDS is likely to particularly affect those households who are already poor. In most cases, the survival strategy of households in the face of HIV/AIDS often involves taking children out of school, which increases the likelihood that these children will have lower income than otherwise.

Whether the total stock of human capital falls or increases over time would therefore depend on the relative importance of formal education or on-the-job training, the evolution of wages, and the extent of poverty. So far, the available evidence suggests that formal education was adversely affected by the HIV epidemic. As shown by

Table 1, the econometric evidence suggests that the secondary school enrollment rate fell in 1990-95 on account of the HIV epidemic.

Social capital. Social capital has recently emerged as an important determinant of growth. As shown by several recent studies, the extent of trust and civic cooperation within countries has been found to matter for economic growth (Knack and Keefer, 1995). Because HIV affects the social structure of local communities, it erodes existing social network and traditional support mechanisms. Equally important are regulation and laws for private sector development. To the extent that HIV/AIDS reduces the skilled labor force, it would adversely affect the ability of government to enforce effective regulation and legal framework. The most likely consequence would be an increase in transaction costs and a reduced efficiency in production. Other effects that have been identified include a possible worsening of insecurity, which could result on account of the large number of orphans who might have to grow up without the support and guidance of adults.

The broad relationship between HIV/AIDS and policy and institutional variables is summarized in Table 2. Some 70 developing countries were classified into two groups according to whether the HIV prevalence rate was below or above 0.4%. The objective was to separate countries into those that would not be much affected by HIV from those that would be. The data of Table 2 is consistent with the hypothesis that HIV/AIDS affects a broad range of institutions. In all cases, the institutional ratings are much worse for countries with an HIV prevalence rate above 0.4% than for those countries with HIV prevalence rate below 0.4%.

Table 2: HIV/AIDS and Indices of Policy and Institutional Ratings

	HIV Prevalence Rates	
	Below 0.4%	*Above 0.4%*
Macroeconomic policies 1/	3.74	3.40
Democracy	-0.08	-0.25
Political instability	-0.16	-0.48
Government effectiveness	-0.23	-0.40
Regulation	-0.06	-0.16
Law	-0.22	-0.51
Graft	-0.32	-0.45

Note: 1/ The index for macroeconomic policies is from the World Bank. A lower value indicates a worse rating. Other indicators are from Kaufman (1999).

The data of Table 2 indicates that there is a relationship between HIV and institutions and policy ratings, but there could be some other factors at work that could account for such relationship. These issues were further analyzed by regressing the policy and institutional ratings variables on HIV/AIDS and other variables (such as the level of development) that could account for specific ratings. As shown by Tables 2 and 3 in Annex, HIV/AIDS was found to have a statistical significant effect on macroeconomic

policy,[10] regulation and government effectiveness. But the effects on laws, political instability, graft and democracy were not statistically significant. The main conclusion is therefore that HIV/AIDS reduces the capacity of governments to implement efficient economic management and adversely affects the enabling environment which is important for private sector development.

II - Economic and Social Determinants of HIV/AIDS

The previous section reviewed the channels through which HIV/AIDS can undermine the determinants of growth. But there is also a reverse causation because the same factors that can lead to economic development are also important factors in the spread of the HIV epidemic. The result can be a vicious development cycle whereby HIV/AIDS undermines the main determinants of growth, which in turn facilitates the spread of the HIV epidemic and further reduces economic growth. In order to stop that cycle, it is important to identify the key determinants of the HIV epidemic. But to be effective, early interventions are crucial.

In the 1980s, the first epidemiological models emphasized sexual behavior (frequency, number of partners and probability of being infected) as the key factor accounting for the spread of HIV. Subsequently, it was recognized that sexual behavior alone could not readily explain the exponential spread of HIV in some countries. For that, some other economic, sociological and cultural factors had to be present.

The main economic variables that have been identified include: life expectancy, labor migration, human capital, income inequality, and gender inequality.[11] As expected, there is a strong relationship between good health (reflected in life expectancy) and HIV/AIDS. Because access to health services is generally dependent on the level of income, there is a positive association between income inequality and HIV/AIDS (Figure 1).

Unequal regional development among countries as well as within countries can induce labor migration to urban areas or other countries. The resulting concentration of single men in urban areas or investment project sites is generally accompanied by a parallel increase in commercial and casual sex with a concomitant rise in the risk of HIV infection. Gender and income inequality make societies more vulnerable to HIV because a woman who is poor relative to men, will find herself exposed to a much greater risk of getting infected with the HIV virus.

Empowerment of women through greater economic independence is associated with a lower HIV prevalence rate (Figure 2).[12] Increasing women's economic independence

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[10] The macroeconomic policy rating of the World Bank is an average of several policy indicators. Among these policy indicators, the only one that was found to be affected by HIV/AIDS was the rating for macroeconomic management, which is consistent with the hypothesis that AIDS-related deaths would adversely affect the management capacity of central governments.

[11] "Confronting AIDS. Public Priorities in a Global Epidemic". World Bank Policy Research Report (1997).

[12] The share of female labor in the industrial sector was taken as an indicator of the lack of market opportunities for women.

does two things. First, it provides women with the financial and legal independence they need to take into account their own welfare at crucial times. Without such independence, women are often not in a position to follow safe prevention techniques which have been found to reduce the risk of HIV infection. Limits on independence include land inheritance laws and legal obstacles to opening banking accounts and starting their own businesses. Second, the availability of market employment opportunities increases the opportunity cost of prostitution. On one hand this implies that fewer women will become commercial sex workers to survive, and on the other hand it also leads to more condom use by commercial sex workers.

Figure 1: Inequality and HIV Prevalence

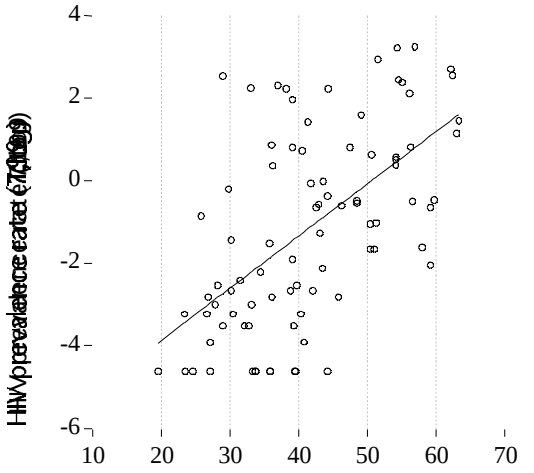
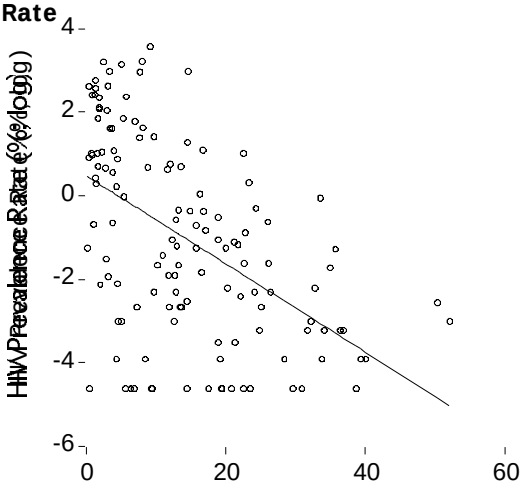


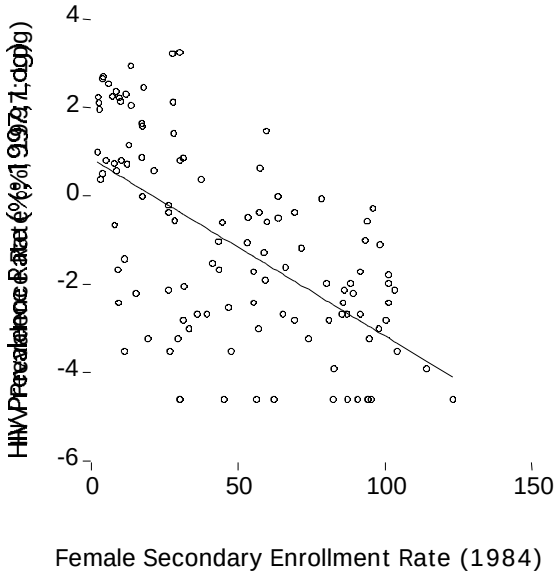
Figure 2: Female Employment and HIV Prevalence Rate



A key determinant of economic independence is education. It is therefore not surprising that education is associated with a lower HIV prevalence rate (Figure 3). Education operates to raise the costs of becoming infected[13] and, particularly if it includes sexual education, it will improve the knowledge of the risks entailed by unprotected sexual relations. Both factors increase the incentives to invest in HIV prevention activities and account for the broad negative relationship between education and HIV.

[13] The cost is proportional to the lost earnings resulting from AIDS-related mortality. This means that educated workers have higher incentives to invest in HIV prevention measures than unskilled workers.

Figure 3: HIV and Female Educat



Sociological and cultural variables include the type of sexual relations, religious belief, and the structure of societies. The type of sexual relations is important because it affects the relative spread of HIV among men and women (Caldwell, 2000). In Africa, HIV is mainly spread through heterosexual relations. As a result, HIV/AIDS affects men and women much more uniformly than in other countries. Religious belief is also an important factor, but its interpretation is subject to conflicting interpretations. Being of Muslim religion is generally associated with a lower HIV prevalence rate, but this could be due to male circumcision, which is thought to reduce the risk of infection.

Ethnic diversity could be an important determinant of the HIV prevalence rate. Ethnically-diverse societies, with some groups being more affected by HIV than others, may experience difficulty in agreeing on spending priorities. The result may be less public spending on public goods as documented by Alesina, Baqir and Easterly (1999). Ethnic diversity may also be associated with an increase in commercial sex.

By contrast, some form of social capital may reduce the spread of HIV. This is most likely to be the case if there is a strong community-based response to the HIV epidemics. One such example includes social capital in the form of information networks, which provide information about HIV to its members. It was found that networks were a much more important source of information in Uganda than in other countries, which could explain why Uganda was able to mount HIV/AIDS intervention activities early on (Low Beer, 2000).

Epidemiological variables include cofactors that increase the risk that sexual contacts will result in HIV infection. Male circumcision could be a possible factor that reduces infection risk (Weiss, Quigley and Hayes, 2000). But the most important cofactor is probably ulcerative sexually transmitted diseases. There are also some indications that HIV is a cofactor of malaria. As is usual in epidemiological models, the age of the epidemic, i.e. how long it has been since the first infectious case was reported in a

country, affects the evolution of the HIV prevalence rate over time. This is even more important for HIV/AIDS because as time passes on, HIV/AIDS weakens the immune response, which allows opportunistic infections to become widespread. The implication is that the economic impact of HIV/AIDS only becomes visible over time.

Table 3: Key Determinants of HIV Prevalence Rate (1997)

Dependent Variable: Log of the HIV prevalence rate	*Coefficient*	*t-Statistic 1/*
Log of the number of phones per person (1994)	-0.84	-2.2**
Growth rate of GDP per capita (1980-90)	4.58	0.5
Share of female labor in industry (1990)	-0.0035	-1.7*
Muslim (% of population)	-0.024	-5.2**
Ethnic fractionalization 2/	0.027	3.5**
Time since first HIV case was reported	0.379	2.9**
Labor migration (1990) 3/	0.003	3.2**
Secondary school enrollment rate (1990) 4/	-0.016	-1.2
Constant	-1.7	-0.85
R-squared	0.69	
Adjusted R-squared	0.64	
Number of countries	59	

Notes:
1/ White heteroskedasticity-consistent standard errors & covariance.
** indicates that the coefficient is statistically significant at the 5% level;
* indicates statistical significance at a 10% level.
2/ Ethnic fractionalization index from Levine, Easterly (1997).
3/ As a proxy for labor migration, the share of factor receipts in exports was used.
4/ Due to multicollinearity between income inequality and gender inequality, the income inequality variable was excluded from the regression. However, when gender inequality is excluded, the income inequality measure is highly significant. For the same reason, female education was replaced by total education to reduce multicollinearity with gender inequality.

The relative importance of these various factors was further explored through a cross-country regression of the HIV prevalence rate for some 60 developing countries for which data is available. Table 3 provides statistical evidence that increased job opportunities for women, improved infrastructure (as measured by the number of telephones per capita), and cultural belief associated with circumcision reduce the prevalence of HIV. Their coefficients are highly statistically significant even when controlling for the level of income per capita and infrastructure by countries.[14]

[14] The education variable is also statistically significant when gender inequality is excluded. Since it is highly correlated with gender inequality, its statistical significance is low when included along with gender inequality as an explanatory variable.

Income inequality and ethnic fractionalization also increase the spread of HIV/AIDS.[15] The most important variable, however, is how long the HIV epidemic has been spreading. The reason is that the HIV epidemic tends to adversely affect the same factors that operate to reduce the spread of HIV/AIDS. For example, as previously discussed, HIV/AIDS tends to reduce the stock of human capital. In the absence of early prevention activities, the loss of human capital would therefore be more important the longer the HIV epidemic has been going on. In turn, the resulting lower level of human capital means that the spread of the HIV epidemic would be stronger than otherwise. In total, these factors explain about 70 percent of the variation of the HIV prevalence rate among developing countries.

III - The Structural Model

The empirical relationship among HIV/AIDS and economic growth was investigated by relating the average growth rate of GDP per capita during the 1990-97 period to the HIV prevalence rate for some 70-80 developing countries for which data is available.[16] Until recently, there was no readily available data on the world-wide prevalence of HIV by country. In 1988, the UNAIDS published the first comprehensive set of data on HIV, which was used for the regressions.[17] One shortcoming is that in the absence of time series, only one HIV prevalence rate per country was available.

As is common in growth regressions, the rate of growth of GDP per capita was averaged over several years to eliminate short-term variations. The years 1990-97 were chosen because they were most likely to be the ones during which the impact of HIV/AIDS would become apparent. One potential shortcoming is that GDP per capita is a biased estimate of the impact of HIV/AIDS. Because it is calculated by dividing GDP by the surviving population, it neglects the welfare of the generation that died because of HIV/AIDS. The principal reason for focusing on GDP per capita is simply that it is widely used in growth regressions.

One of the main difficulties involved in assessing the impact of HIV/AIDS on growth is a fundamental identification problem. Does HIV affects policy variables and institutional variables, or do institutional variables also cause HIV? To address that question, a system of three equations is used to model explicitly the interactions among HIV/AIDS, policy and institutional variables and growth.

The first equation expresses economic growth as a function of macroeconomic policy ratings, institutional variables and other variables that are important determinants of economic growth. Macroeconomic policy ratings and institutional variables are in turn linked to the HIV prevalence rate through a second equation. The third equation expresses the HIV prevalence rate as a function of the main determinants that were found to be important for the spread of HIV.

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[15] By contrast, medical expenditures per person were not statistically significant.

[16] Developed countries were excluded partly due to the lack of data concerning some of the policy variables that were used in the econometric estimation, and partly because the spread of HIV in developed countries reflects different causes (non-heterosexual) than Africa. Other countries in Eastern Europe that showed a substantial fall in the rate of growth of GDP per capita were also excluded as the declines were due to political factors that were not captured in the growth equation.

[17] World Development Indicators, 1999, World Bank. However, most estimates while published in 1998 refer to the period 1993-96.

Growth Equation. The starting point is a growth framework that is similar to that found in the growth literature (Barro, 1997). The average rate of growth of GDP per capita for country i (Growthi) is expressed as a function of the initial per capita income of country i, infrastructure, policy ratings, human capital, other exogenous variables (Zi), and a random disturbance terms (Ui). Various variables Zi were tried to test their statistical significance. These included geography (whether the country is landlocked and/or is tropical), the prevalence of malaria, and dummy variables (for Latin America and or Africa). In mathematical terms, the growth equation for country i can be written as:

$$(1) \quad Growthi = \alpha_0 + \alpha_1 LnYi + \alpha_2 Ln(Phone) + \alpha_3 (Macroi) + \alpha_4 (Law) + \alpha_5 (HCi) + \alpha_6 Zi + Ui$$

where α_0 is a constant and i represents country i.

Policy and Institutional Variables and HIV. Explanatory variables were taken to include per capita income, the initial rating of economic policies at the beginning of the period, the level of development, human capital, the HIV prevalence rate, and a dummy variable for Southern Africa. Growth during the preceding period (1980-90) was also included to allow for reverse feedback effects from economic growth. Vi is a random disturbance term for country i.

The simple epidemiological model described in Annex has one important implication, namely that the change in the HIV prevalence rate is a function of the prevalence rate and its square. It is for this reason that the HIV prevalence rate and its square (in logarithms) are included in equation (2).

$$(2) \quad Macroi = \gamma_o + \gamma_1 Ln(Yi) + \gamma_2 LnPhone + \gamma_3 HCi + \gamma_4 ICRG + \gamma_5 Growth(t\text{-}1)i + \gamma_6 Ln(HIVi) + \gamma_7 (LnHIVi)^2 + \gamma_8 Dummy + Vi$$

HIV and its determinants. The determinants of HIV discussed in the previous section, are included in equation (3). Economic growth (Growthi) is included to test whether the HIV prevalence rate is affected by reverse feedbacks from growth. As before, Wi is a random disturbance term.

$$(3) \quad Ln(HIVi) = \beta o + \beta_1 Ln(Phone) + \beta_2 (Growthi) + \beta_3 (Gender) + \beta_4 (Muslim) + \beta_5 (Ethnic) + \beta_6 Time + \beta_7 (Migration) + \beta_8 (Education) + Wi$$

The list of the principal variables and their definition are as follows:

Education:	Secondary school enrollment rate in 1990
Ethnic:	Extent to which different languages are used.
ICRG:	Rating of macroeconomic outcome by country in 1990
Growthi:	Average rate of growth of GDP per capita in 1990-97
Growth(t-1)i:	Average rate of growth of GDP per capita in 1980-90
Gender:	Share of female labor in industry in 1990
Law	Rating of the legal framework, 1995-96

Ln(Yi):Natural logarithm of per capita income in 1990
LnPhone: Natural logarithm of phones per capita in 1994
Macroi: Rating of macroeconomic outcome by country in 1998
Malaria: Malaria morbidity in 1990
Migration: Share of factor receipts in exports in 1990
Muslim: Share of the population that was Muslim in 1990-95
Time: Number of years since the first HIV case was first reported

Empirical Results

Equations (1), (2) and (3) were first estimated using Ordinary Least Squares (OLS). The assumption underlying OLS is that the explanatory variables are exogenous. In fact, they may be endogenous to the 1990-97 growth process. As is standard in the growth literature, the explanatory variables were therefore measured at the beginning of the 1990s to reduce the bias that endogeneity may introduce. Such solution was not feasible for the HIV prevalence rate and some institutional variables since their value was only available for the mid-1990s. The alternative standard solution of using instruments for these endogenous variables was followed and the three equations were estimated using Two Stage Least Squares (TSLS). Different specifications were tried for the growth equation to test for the potential bias that omitted variables (such as other diseases like malaria) could introduce.

An empirical issue is which policy and institutional variables to include in the growth equation (1). In principle, the ratings for government effectiveness, regulation and macroeconomic policy should be included in the regression, but this would introduce multicollinearity as these variables are highly correlated. For this reason, the growth equation was estimated with the ratings for law and macroeconomic policy only.

As a proxy for the stock of human capital, school enrollment rates were used. While they do not measure satisfactorily the stock of human capital –in particular, they exclude on the job training—they perform better than some of the more comprehensive estimates of human capital.[18]

The *Ordinary Least Squares* (OLS) results of estimating the growth equation (1) are consistent with the findings of the growth literature (Annex, Table 1, first column). Nearly all the coefficients are statistically significant with the expected sign. The coefficient of income per capita is negative, which is consistent with the hypothesis of conditional convergence of GDP per capita between poor and rich countries (Barro, 1997). The level of infrastructure and the primary school enrollment rate are significant with the expected positive effect on GDP growth. Nevertheless, this regression does not explain Africa's growth too well. The coefficient of the dummy variable for Latin America is quite large, implying that most of the difference in growth between Africa and Latin America is left unexplained.

Introducing HIV/AIDS as an additional explanatory variable indicates the importance of infectious diseases for Africa's growth. As shown by the second column of Table 1

[18] For examples, the Barro estimates of the number of years of schooling did not perform well.

(Annex), the dummy variables for Africa and Latin America are no longer significant, but the coefficient of the HIV prevalence rate is highly significant.

Malaria and growth. What could account for the large OLS estimate of the impact of HIV on growth is the omission of relevant variables from the growth regression. If these variables are positively correlated with HIV, the coefficient of HIV would be biased upwards as it would include their impact. Among the possible diseases that are important for Africa, malaria stands out.[19] Following the approach of McCarthy, Wolf and Wu (2000), data on the morbidity caused by malaria was used to construct an index of morbidity rate per 100,000 persons.[20] The average malaria morbidity rate for 1985-90 was included in the regression, but the results were quite similar if the 1990 index was used instead. Overall, the statistical significance of the malaria variable is low, but this is due mainly to the poor quality of the malaria data. In any case, the results suggest that the per capita growth of the countries affected by malaria was reduced by 0.3 percentage points per year in 1990-97. As shown by the third column of Table 1 (Annex), including the malaria morbidity rate in the growth regression does not affect much the estimated impact of HIV/AIDS on growth.[21]

As a test for the importance of other exogenous factors, various dummy variables were included in the growth regression. Dummy variables for country location (tropical), or whether a country is landlocked, were not statistically significant. As an indicator of openness, the 1990 share of exports in GDP was also included. This variable was significant only when the HIV and the malaria variables were excluded. The fact that these various variables are not significant when the HIV and the malaria variables are included provides additional support for the importance of infectious diseases for developing countries, and especially Africa's economic and social development.

Empirical Results (Two Stage Least Squares)

The OLS estimates shown in the previous section assume that both the HIV prevalence rate and the policy variables are exogenous. However, these variables are most likely to be endogenous, which raises the issue of how to identify the system of equations (1), (2) and (3). However, there are a number of restrictions on the coefficients of the three equations which make it possible to estimate the growth equation with Two Stage Least Squares (TSLS) and using instrumental variables for the endogenous variables.

The first simplification concerns the equation for the macroeconomic policy rating. Past (1980-90) or current (1990-98) economic growth are not statistically significant, and they were therefore removed from that equation. Similarly, the policy and institutional variables (macroeconomic rating and rule of law) and past or current economic growth are not statistically significant when included in the equation for HIV.

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[19] For an econometric analysis of the impact of malaria, see also Gallup and Sachs (1998).

[20] Published by the World Health Organization (WHO) in its Weekly Epidemiological Record, 8/13/99, www.who.int/wer.

[21] As an alternative to the 1990 malaria rate, the increase in the average morbidity rate from 1985-90 to 1990-95 was also included, but it was not significant. The most likely reason is data issues. For some countries, the increases in morbidity rates are too large to be readily explainable. Most likely, it reflects differences in data collection.

These variables were also omitted from the HIV equation. The result is the following simplified system of equations (4), (5) and (6):

(4) $Growthi = \alpha_0 + \alpha_1 Ln(Yi) + \alpha_2 Ln(Phone) + \alpha_3 Macro + \alpha_4 Law + \alpha_3 HCi + \alpha_4 Malaria + Ui$

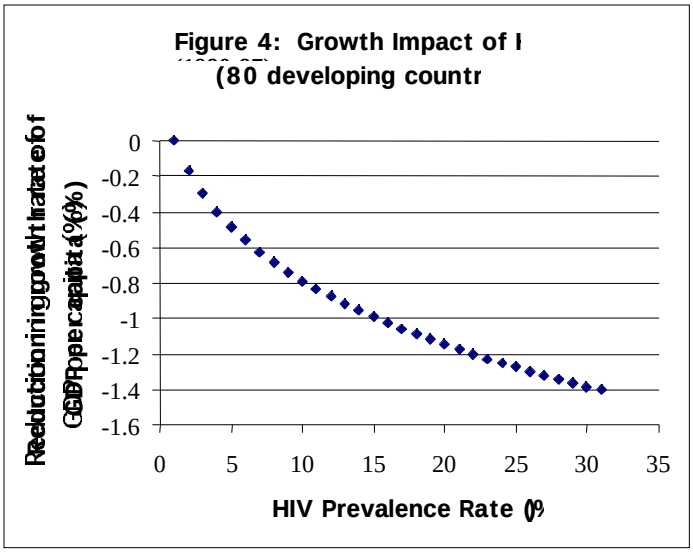
(5) $Macroi = \gamma_o + \gamma_1 LnYi + \gamma_2 HCi + \gamma_3 ICRG + \gamma_4 Ln(HIVi) + \gamma_5 (LnHIVi)^2 + \gamma_6 Dummy + Vi$

(6) $Ln(HIVi) = \beta o + \beta_1 Ln(Phone) + \beta_2 (Growthi) + \beta_3 (Gender) + \beta_4 (Muslim) + \beta_5 (Ethnic) + \beta_6 Time + \beta_7 (Migration) + \beta_8 (Education) + Wi$

The main remaining issue is the endogeneity of the ratings for macroeconomic policy and the rule of law in the growth equation. It was addressed by using instruments that are highly correlated with these variables. The 1990 country rating (Institutional Country Rating from Institutional Investor) was used as an instrument for the 1998 macroeconomic policy rating and the index of democracy (Voice) served as instrument for the rule of law. For the malaria variable, the 1990 share of urban population and the percentage of population with access to water were used as instruments. Other instruments used for the policy and HIV equations are indicated in Table 1, 2, and 3 in Annex.

As shown by the last column of Table 1 (Annex), the TSLS results for the growth equation are broadly similar to the OLS estimates. Some of the estimated coefficients are no longer significant, but this is most likely due to the reduction in the sample size due to the TSLS procedure. In any case, the overall estimated impact of the HIV/AIDS is quite similar to the value obtained through the OLS estimates.

Growth impact of HIV/AIDS. The estimated growth impact of HIV/AIDS is obtained by substituting the equation for the macroeconomic policy rating into the growth equation. Figure 4 shows the reduction in the growth rate of GDP per capita resulting from HIV/AIDS while holding constant the other factors that affect growth.



For low prevalence rate countries the estimated growth impact is small. For Africa with an average HIV prevalence rate of 8 percent, the rate of growth of GDP per capita was reduced by about 0.7 percentage points per year in the 1990s. In other words, had the HIV prevalence rate not reached 8.6% in 1999, Africa's income per capita would have grown at 1.1 percent per year – or nearly three times the average growth (0.4 percent) achieved in 1990-97.

The impact on GDP is even more substantial, and especially for high prevalence rates countries. In the case of a typical sub-Saharan country with a prevalence rate of 20 percent, the rate of growth of GDP would be some 2.6 percentage points less each year.[22] At the end of a twenty year period GDP would be 67 percent less than otherwise. One reason for the large impact of HIV/AIDS is that it includes the effect of AIDS-related opportunistic infections and other communicable diseases.

Poverty implications. The economic impact of HIV/AIDS will not be uniform across countries or even within countries. Countries that are well developed with a strong health infrastructure can usually mobilize the resources needed to prevent early on the rapid spread of HIV/AIDS. They can take advantage of a widespread medical infrastructure to dispense the medication that can allow HIV-infected individuals to remain engaged in economic activities. Furthermore, because of their well-developed educational system and stock of human capital, the AIDS-related loss of human capital does not entail the same consequences it has in countries where skilled labor is already in short supply.

By contrast, countries which do not have such resources are particularly vulnerable to a rapid spread of HIV and a subsequent vicious downward circle. This is especially true for countries with already weak social capital, which gets further eroded by the spread of HIV/AIDS. In such an environment, a vicious cycle is set in motion whereby lower growth increases poverty. With the infection of adults in families, breadwinners fall ill

[22] This is the sum of the reduction in growth per capita (1.2 percent) and the shortfall in population growth (1.4 percent)

and stop earning. Children are then often taken out of school to look after the ill-members of the families, which sharply constrains children's opportunities for higher income later in life. In such circumstances, the poor are forced to reduce their expenditure on food, which reduces further their resistance to the opportunistic infections made possible by HIV/AIDS. The consequence is increased poverty and the reversal of most development gains.

How to increase Economies' Immunity to HIV

As shown by the previous system of equations the relations between HIV/AIDS and economic development are complex, particularly because of reverse causality. While HIV/AIDS reduces economic growth, economic growth can increase or decrease the spread of the HIV epidemic. On one hand, economic development can slow down the spread of the HIV epidemic. This is most likely when economic growth leads to rapid increase in education, especially female education, general improvement in physical infrastructure (which improves access to health and safe water), and employment opportunities for women. On the other hand, the process of economic development can facilitate the spread of the HIV epidemic. This is particularly the case if development is associated with substantial labor migration within and among countries, investment in large projects, and political changes that result in social changes.

What separates this two alternative outcome is how long the HIV epidemic has been on-going without any nation-wide HIV prevention activities. A key implication of infectious diseases is that they tend to spread exponentially in the population once some threshold is reached. The implication is that the growth effects of the HIV epidemic will be more pronounced the older the HIV epidemic. These effects include: (i) lower school enrollment; (ii) higher income inequality (because it rises with lower economic growth); (iii) fewer employment opportunities for women in the modern sector; and (iv) less investment in physical (and medical) infrastructure. The lack of early HIV prevention activities therefore increases the likelihood of a vicious cycle of underdevelopment.

The issue faced by governments is that inaction early on makes it much more difficult to provide care and treatment latter on. One reason is that HIV/AIDS reduces the capacity of governments to provide health and education services at a time when they are the most needed. As is shown by the experience of Southern African economies, the HIV/AIDS epidemic has not spared government services (World Bank, 2000a).

The second reason is that once the HIV prevalence rate reaches a high level, the budgetary cost of intervention, treatment and care of AIDS patients rises dramatically (World Bank, 2000a). High-income countries can finance such costs, but this is unlikely to be the case for most developing countries without external assistance. The only exception is those developing countries that have invested early on in prevention activities. By keeping the number of new infections at a low level, the future number of AIDS patients remains low, and these countries can afford the cost of care and treatment.

Reversing the spread of the HIV/AIDS epidemics and mitigating its impact will therefore require four sets of measures:

- Sound macroeconomic policies. Among the determinants of growth, macroeconomic policies have the largest impact on growth. In view of recent work showing that growth has a substantial impact on poverty (Dollar,2000), growth-enhancing policies may create a virtuous circle. Growth can provide the fiscal resources needed for governments to address on a sustainable basis the effects of the HIV/AIDS epidemic.

- Structural policy reforms aimed at addressing some of the factors that account for the spread of HIV, namely income inequality, gender inequality (unequal employment opportunities for women), and the adverse impact of ethnic divisions. Enhancing the role of social capital (in the form of networks and support groups) would seem the most promising intervention. In addition, an enabling environment may need to be created. This means addressing the legal or social constraints which adversely affect the capacity of seropositive individuals from participating in economic activities.

- Modifying further the system of incentives faced by individuals. This topic has not been discussed in the paper, but unless incentives are provided for HIV-infected adults to change their behavior, HIV prevention activities may not be effective. One immediate policy could be to restore hope by improving access to health care and treatment. Treatment of AIDS-related opportunistic infectious diseases such as tuberculosis as well as treatment of key cofactors of HIV such as STDs, have the potential of extending life expectancy substantially. Both the drugs and the medical knowledge to address these diseases are available.

Annex

Economic Growth and the HIV/AIDS Epidemic

An implication of endogenous growth models is that growth is a function of changes in the level of policies. As concerns HIV/AIDS, this implies that economic growth is a function of the absolute change in the HIV/AIDS prevalence rate. The implication can be analyzed in the context of a simple model of infectious diseases. In such a model each infected person makes c.dt contacts over the period dt.

If I(t) is the number of infected individuals at time t, and P(t) is the total population, the percentage of the population that is not infected is given by:

$$\frac{[P(t) - I(t)]}{P(t)}$$

The number of new infections caused by one person is simply:

$$\frac{c.dt[P(t) - I(t)]}{P(t)}$$

Since each I(t) infected individuals makes c contact per period, the increase in the number of new infections during period dt is:

$$\frac{dI(t)}{dt} = \frac{c.I(t).[P(t) - I(t)]}{P(t)}$$

By definition, the prevalence rate h(t) is equal to I(t)/P(t). Taking the derivative of h(t) and substituting its value in the preceding expression gives:

$$\frac{dh(t)}{dt} = c.h(t).[1 - h(t)]$$

This equation makes it possible to simplify the relation between economic growth and the change in the prevalence rate. The change in the prevalence rate (which is not known) can be replaced by its approximation in terms of h and h^2.

Table 1: Growth and HIV/AIDS (1990-97) 1/

		Rate of growth of GDP per capita		
	OLS	**OLS**	**OLS**	**TSLS 2/**
Constant	0.14**	0.11**	0.12**	0.027
	(2.99)	(2.62)	(2.64)	(0.3)
Log GDP 1990 2/	-0.033**	-0.029**	-0.03**	-0.01
	(-4.2)	(-3.9)	(-3.9)	(0.8)
Log phone per capita 1994	0.014*	0.014*	0.013*	-0.001
	(1.96)	(1.9)	(1.8)	(-0.1)
Macro rating (1998) 3/	0.010*	0.014**	(0.012**	0.008
	(1.95)	(3.08)	(2.86)	(0.3)
Law rating (1995-96) 4/	0.017**	0.014**	0.017**	0.024*
	(2.63)	(3.04)	(3.0)	(1.9)
Primary enrollment rate1990	0.0004**	0.0005**	0.0005**	0.0005*
	(2.22)	(3.2)	(3.2)	(1.8)
Log of HIV prevalence rate		-0.0002	-0.0015	
		(-0.93)	(-0.66)	
Log of HIV prevalence rate, squared		-0.0025**	-0.002**	
		(-3.4)	(-2.51)	
Malaria morbidity (per 100,000 persons)			-5.1E-07	-6.6E-07
			(-1.13)	(-1.4)
Dummy variable Latin America	0.020**	0.010	-0.0008	
	(2.38)	(-0.97)	(-0.09)	
Dummy variable Africa	-0.004	-0.004	-0.007	
	(-0.5)	(-0.41)	(-0.72)	
R^2	0.33	0.46	0.47	0.41
Adjusted R^2	0.27	0.39	0.37	0.32
No. of countries	86	81	78	47

Notes:

1/ Heteroscedasticity-consistent t statistics in parentheses (White correction). * indicates significance at 10% level; ** significance at 5% level.

2/ In purchasing power parity terms. (World Development Indicators).

3/ World Bank unpublished ratings.

4/ Kaufman. "Governance Matters" World Bank Working Paper No. 2196 (October 1999).

3/ TSLS: instruments include: LnGDPPC90, Primary school enrollment rate (1990), index of democracy (Voice index from Kaufman, 1999), 1990 country rating (from Institutional Investor), the 1990 share of factor receipts in exports, the 1990 share of urban population and the 1990 access to safe water.

Table 2: Macroeconomic Policy and HIV/AIDS 1/

	Macroeconomic Policy Rating (1998) 2/	
	Ordinary Least Squares	*Two Stage Least Square 5/*
Constant	1.57 (1.0)	1.82 (1.3)
Growth rate of GDP per capita (1980-90)	0.20 (0.04	
Log of HIV prevalence rate (1997)	-0.21** (-2.2)	-0.34** (-3.1)
Log of HIV prevalence rate, squared	-0.06** (-2.4)	-0.11** (-2.7)
Institutional Country Rating (1990) 3/	0.019 (1.6)	0.023* (1.96)
Log of phone (1994)	0.029 (0.14)	
Primary school enrollment (1990)		-0.014** (-2.2)
Log of GDP per capita (1990) 4/	0.162 (0.5)	0.27 (1.15)
Dummy variable for Southern Africa	1.12** (2.7)	1.91** (3.8)
R^2	0.25	0.29
Adjusted R^2	0.12	0.18
No of countries	58	46

Notes:

1/ Heteroscedasticity-consistent t statistics in parentheses (White correction). ** indicates that the coefficient is statistically significant at the 5% level; * indicates statistical significance at a 10% level.

2/ World Bank unpublished ratings.

3/ Institutional Investor Guide; average economic rating by country (1990).

4/ In purchasing power parity terms. (World Development Indicators).

5/ TSLS: instrument list: Log of GDP per capita (1990), primary school enrollment rate (1990), 1990 country rating (from Institutional Investor), the 1990 share of factor receipts in exports, the 1990 share of urban population, share of Muslims in population, share of female labor times ethnic fractionalization index, 1980-90 rate of growth of GDP per capita, dummy variable for Southern Africa, and number of years since beginning of HIV epidemic.

Table 3: Institutional Variables and HIV/AIDS 1/
(Ordinary Least Squares Estimates)

	Law2/	*Regulation 2/*	*Government Effectiveness 2/*
Constant	-2.9**	-1.31**	-1.77
	(-3.6)	(-2.4)	(-1.5)
Log of GDP per capita (1990) 3/	0.26	n.s.	-0.09
	(1.7)		(-0.4)
Secondary school enrollment rate (1990)	n.s.	0.001	0.002
		(0.2)	(0.4)
Growth rate of GDP per capita (1980-90)	3.36.2	-1.73	0.44
	(1.05)	(-0.5)	(0.14)
Log of phone per capita (1994)	0.26*	0.26**	0.25
	(1.7)	(2.4)	(1.7)
Institutional Country Rating (1990) 4/	0.022**	0.009	0.025**
	(2.4)	(1.19)	(3.14)
Log of HIV prevalence rate (1997)	-0.09	-0.17*	-0.12
	(-1.4)	(-2.0)	(-1.6)
Log of HIV prevalence, squared	-0.01	-0.051**	-0.048**
	(-0.5)	(-2.8)	(-3.2)
Dummy variable for Southern Africa	0.52	0.96**	0.58*
	(1.5)	(2.3)	(1.9)
R^2	0.52	0.38	0.45
Adjusted R^2	0.46	0.30	0.36
No of countries	64	61	60

Notes:
1/ Heteroscedasticity-consistent t statistics in parentheses (White correction). ** indicates that the coefficient is statistically significant at the 5% level; * indicates statistical significance at a 10% level.
2/ Kaufman. "Governance Matters" World Bank Working Paper No. 2196 (October 1999).
3/ In purchasing power parity terms.(World Development Indicators).
4/ Institutional Investor Guide; average economic rating by country (1990).

References

AINSWORTH, MARTHA AND OVER, MEAD. 1994. "Aids and African Development" The World Bank Research Observer. 9 (2)

ALESINA, ALBERTO, REZA BAQIR, AND EASTERLY WILLIAM. 1999 "Public Goods and Ethnic Divisions" Quaterly Journal of Economics, November 1999.

BARRO, ROBERT J. 1997. "Determinants of Economic Growth: A Cross-Country Empirical Study". Cambridge MA: MIT Press.BLOOM E. DAVID AND MAHAL, AJAY S. 1997. "Does the AIDS Epidemic Threaten Economic Growth?" Journal of Econometrics 77, 105-124.

CALDWELL, JOHN C., 2000. "Rethinking the African AIDS Epidemic". Population and Development Review 26 (1): 117-135, March 2000

COLLIER, PAUL, HOEFFLER, PAUL. 1999. "On Economic Causes of Civil War". Oxford Economic Papers 50 (1998), 563-573.

CUDDINGTON, JOHN T., 1993. "Modeling the Macroeconomic Effects of AIDS with an Application to Tanzania" The World Bank Economic review 7 (2):173-89

DOLLAR, DAVID, KRAY, AART. 2000. "Growth is Good for the Poor". World Bank, Working Paper, March 2000 (also at: www.worldbank.org/research/growth).

EASTERLY, WILLIAM AND ROSS LEVINE. 1997. "Africa's Growth Tragedy: Policies and Ethnic Divisions," Quaterly Journal of Economics, CXII (4), 1203-1250.

EASTERLY, WILLIAM AND ROSS LEVINE. 2000. "It is not Factor Accumulation; Stylized Facts and Growth Models". World Bank Working Paper (January 2000).

GALLUP, JOHN LUKE, SACHS, JEFFREY D. (1998). "The Economic Burden of Malaria" Harvard Center for International Development. October 1998.

GALOR, ODED, AND WEIL, DAVID N. 1999. "From Malthusian Stagnation to Modern Growth", American Economic Review, May 1999, 89 (2):150-155.

KAMBOU G. S., S. DEVARAJAN AND MEAD OVER. 1992. "The Economic Impact of AIDS in an African Country: Simulations with a General Equilibrium Model of Cameroon." Journal of African Economies 1 (1):109-30.

KAUFMAN, DANIEL, KRAAY, AART, AND ZOIDO-LOBATON, PABLO. 1999A. "Aggregating Governance Indicators". World Bank Working Paper No. 2195.

KAUFMAN, DANIEL, KRAAY, AART, AND ZOIDO-LOBATON, PABLO. 1999B. "Governance Matters". World Bank Working Paper No. 2196.

KNACK, STEPHEN, KEEFER, PHILIP. 1997. "Does Social Capital Have an Economic Payoff? A Cross-Country Investigation" The Quaterly Journal of Economics, November 1997.

KNACK, STEPHEN, KEEFER, PHILIP. 1995. "Institutions and Economic Performance: Cross-Country Tests Using Alternative Institutional Measures". Economics and Politics, 7 (3): 207-227.

LOW-BEER, DANIEL, STONEBURNER, RAND, BARNETT TONY, WHITESIDE ALAN. OCTOBER 2000. "A Socio-Economic and Epidemiological Study of Ugandan "Successes" With Lessons for Regional Application." Notes presented at World Bank seminar.

MCCARTHY, F. DESMOND, WOLF, HOLGER, AND WU, YI. MARCH 2000. Policy Research Working Paper No. 2303, World Bank.

OVER, MEAD. 1992. "The macroeconomic Impact of AIDS in Sub-Saharan Africa." AFTPN Technical Working Paper No.3 World Bank, Africa Technical Department, Population, Health and Nutrition Division, World Bank.

UNAIDS. 1999. "Level and Flow of National and International Resources for the Response to HIV/AIDS, 1996-97"

WEISS, HELEN A., QUIGLEY, MARIA A. AND HAYES RICHARD J. 2000. "Male Circumcision and Risk of Infection in Sub-Saharan Africa: a Systematic Review and Meta Analysis". AIDS, Vol. 14, No. 15.

WORLD BANK. 1997. "Confronting AIDS Public Priorities in a Global Epidemic". World Bank Policy Research Report. Oxford University Press.

WORLD BANK, 2000a. "Exploring the Implications of the HIV/AIDS Epidemic for Education". World Bank, ACT*africa* (AIDS Campaign Team for Africa), November 2000.

WORLD BANK, 2000b. "Costs of Scaling HIV Program Activities to a National Level in Sub-Saharan Africa: Methods and Estimates". World Bank, ACT*africa* (AIDS Campaign Team for Africa), November 2000.