

EXAMINING THE IMPACT OF HIV-PREVALENCE ON ECONOMIC GROWTH IN SUB-SAHARAN AFRICA: A Panel Data Analysis

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ABSTRACT

In the current project, we want to study the impact of HIV prevalence rates on economic growth in 40 developing countries from Africa over the period of 2005 to 2009. We want to create a panel data set and use a fixed/random effect model to test the impact of HIV prevalence.

Most of the studies that exist in this field are case studies that deal with one country at a time. Or they are survey types of studies that do not go into regression and estimation techniques. Also, other authors have used computer simulation based production function models to examine this question.

We want to cover this gap in the existing literature with our paper through using a new method, which is the fixed-effect and random effect model. Therefore, our study will supplement the existing literature on the topic by providing empirical evidence/support for the adverse impacts of HIV prevalence on economic growth rates. The conventional literature on macroeconomic impacts of HIV states that "AIDS Has Little Net Macroeconomic Impact" (using per capita GDP as a metric). However, we prove that HIV prevalence (the percentage of the population living with HIV) has significant negative impacts on per capita GDP.

Initial findings show that HIV prevalence has a negative impact on economic growth. This is true in all countries included in this stud. On the other hand, countries with the highest level of income per capita show such an inverse association. Countries that have lower and medium per capita income do not show such an association.

INTRODUCTION

In his paper, Arndt *et al.* (2000) stated that "The key question is how to deal with the impending crisis (the authors refer to the HIV epidemic)". The same authors also noted that "the epidemic has gradually moved beyond its earlier status as a health issue to become a development issue, with social, political, and economic dimensions. "In this paper, we only deal with the economic aspects of the problem." Unless the threat posed by HIV is properly and adequately addressed, the disease will continue to take its toll on the lives of those who are affected, on their families,

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and on their communities. The scarce resources available will all be used in fighting HIV rather than being invested in other sectors of the economy. This diversion will reduce investment and economic growth in the long run.

The statistics about the impact of HIV/AIDS are overwhelming. This will help us justify the need for the present study. Estimates done by the United Nations Agency of AIDS (UNAIDS) indicate that over 40 million people were living with HIV/AIDS in 2001, nearly 25 million people have died because of HIV/AIDS since the disease was first discovered in the early 1980's, and that more than 15.6 million children under the age of 15 have lost either their mother, their father, or both parents as a direct result of HIV/AIDS (UNAIDS, 2001). Let us now compare the present situation with the past one; UNAIDS (2010) estimates that there were 33.3 million (31.4 million–35.3 million) people living with HIV at the end of 2009 compared with 26.2 million (24.6 million–27.8 million) in 1999—a 27% increase.

The UNAIDS Global Report (2010) also shows that the Sub-Saharan Africa still bears an inordinate share of the global HIV burden. Although the rate of new HIV infections has decreased, the total number of people living with HIV continues to rise; however, due to improvement in HIV treatment, the number of HIV/AIDS deaths has decreased. In 2009, people with new HIV infections in sub-Saharan Africa reached 22.5 million (20.9 million–24.2 million), which is 68% of the global total. The same report shows that Sub-Saharan Africa has more women than men living with HIV. It also shows that in sub-Saharan Africa—Ethiopia, Nigeria, South Africa, Zambia, and Zimbabwe has huge problem with the disease. This clearly shows the urgent need to study the HIV/AIDS epidemic with special emphasis on the Sub-Saharan Africa region.

The same report also shows that the new HIV infections are declining worldwide. The report states that “In 2009, there were an estimated 2.6 million [2.3 million–2.8 million] people who became newly infected with HIV. This is nearly one fifth (19%) fewer than the 3.1 million [2.9 million–3.4 million] people newly infected in 1999, and more than one fifth (21%) fewer than the estimated 3.2 million [3.0 million–3.5 million] in 1997, the year in which annual new infections peaked. In 33 countries, the HIV incidence has fallen by more than 25% between 2001 and 2009; 22 of these countries are in sub-Saharan Africa. In sub-Saharan Africa, where the majority of new HIV infections continue to occur, an estimated 1.8 million [1.6 million–2.0 million] people became infected in 2009; considerably lower than the estimated 2.2 million [1.9 million–2.4 million] people in sub-Saharan Africa newly infected with HIV in 2001. This trend reflects a combination of factors, including the impact of HIV prevention efforts and the natural course of HIV epidemics.”

Notwithstanding the fact that the epidemic kills across nations, the volume of the study on the impact of HIV prevalence and on economic growth, based on the large-sample of countries, is still not enough. Most studies deal with only a limited number of countries and do not use the panel data estimation technique. As a result, the debate on the role of HIV prevalence on economic growth continues. Different authors have used other methods to examine this question. We will show in the literature review section that earlier studies support “no impact of prevalence on economic growth”; however, more recent studies show a “significant negative impact of prevalence in economic growth”. Moreover, majority of the progress made so far does not

cover the economic dimension of HIV/AIDS. Therefore, the urgent need for more research on this topic can hardly be overemphasized.

The current paper was divided into the following sections: Section 2, which presents literature review; Section 3, which presents data and methodology; Section 4, which presents regression results and Section 5, which concludes the paper.

SECTION 2

Literature Review

Bloom and Mahal (1997) studied the relationship between HIV prevalence and economic growth rates in 51 countries between 1980 to 1992 and 1987 to 1992. The authors show that in both periods, the negative relationship between economic growth and the rise in HIV prevalence is a spurious one. The authors argue that the negative relation is explained by the fact that HIV increased most in countries with low income per capita. Many previous studies believed that this was the case. However, several new studies, which we have also mentioned below, show different results. In order to highlight the complex-dimension of HIV/AIDS and different ways in which HIV/AIDS affect human beings, we present two sets of diagrams in the non-statistical appendix at the end of the paper. We also present the impact of HIV/AIDS on an individual and his family (Sarker, 2011) and for the entire economy (Arndt, 2000).

Bonnel (2000) used a cross-sectional analysis and found a strong negative association between HIV prevalence in adults and per capita GDP growth. He found that the annual per capita GDP growth is reduced by about 1% due to 15% HIV prevalence rate in adults. The author of this study also found that without HIV/AIDS, the selected African countries would have grown at a rate of 1.1% per year as opposed to .4%, which is their current growth. In low prevalence countries in Africa and elsewhere, the growth impact is negligible.

Dixon *et al.* (2001) used a panel data approach; however, they did not find evidence on the impact of HIV prevalence on economic growth. This study covered 41 African countries over the period of 1960 to 1997. The authors found that there was a reduction of 1.3% in economic growth at an HIV prevalence of 20%.

Anand *et al.* (1999) assessed the total annual cost of HIV for the period between 1986 and 1995 in India. In this study, the authors followed a novel approach based on a break-down of the total annual cost of HIV. Therefore, in the paper, the total annual cost of HIV included: the loss of productivity among patients with HIV-related illness; HIV-caregivers loss of productivity; and the cost of management of patients with HIV-related illness. Authors concluded that the estimated annual cost of HIV ranges between 1.0 to 1.1% of the GDP, depending on the assumption made about prevalence.

Arndt *et al.* (2003) examined the impact of HIV prevalence on economic growth in Mozambique using the Computable General Equilibrium (CGE) model. The authors found that per capita annual GDP growth rates are between 0.3% and 1.0%, which is lower than in a “no-AIDS” scenario. The model identified three significant channels which slowdown the increase

of the GDP: first, reduced productivity growth; second, reduced population growth, and third; reduced physical capital accumulation.

Corrigan *et al.* (2005) studied the impact of HIV on economic growth via the human capital accumulation channel. They projected a decline of 30-40% in per capita GDP growth for countries with adult infection rates of 15-20%.

Many studies have dealt with the impact of HIV on economic growth in terms of Computable General Equilibrium (CGE) model/Cobb-Douglas production function model. These models are very different from our empirical paper. The CGE models are mathematical models based on production functions and other structural equations that create the model economy. Over (1992) developed a model to estimate the impact of HIV on the growth of GDP per capita over the period of 1990 to 2025, under alternative assumptions about the distribution of the epidemic and the financing costs. The author included 30 countries in the sample. The author represented the growth process using two generalized Cobb-Douglas production functions; one for the rural sector and one for the urban sector. Under a set of stringent assumptions, Over (1992) found that HIV depresses the GDP growth rate by 0.33% a year. Other studies by Arndt *et al.* (2000), Quattek (2000), Nicholls *et al.* (2000), and Cuesta (2001) showed a similar impact with CGE models.

The problem associated with the CGE evidence is that these models are highly mathematical; they depend on a set of stringent assumptions, and the results are valid only under those assumptions. The CGE models are not econometric. They do not show impact across social groups or sectors. Therefore, we create a panel dataset in this study to analyze the impact of HIV prevalence on GDP per capita.

Salinas *et al.* (2006) studied the relationship between HIV/AIDS prevalence and poverty and inequality. Authors used datasets from both HIV prevalence datasets and income/expenditure surveys (On four countries, Ghana, Kenya, Swaziland, Zambia) to conduct various statistical analyses and simulation exercises. They found that the epidemic lowers the average income and increases poverty, especially among populations living on the threshold of poverty.

Bloom *et al.* (1995) used a dataset of 51 developing countries and industrial countries. They studied the relationship between changes in the prevalence of AIDS and the growth rate of GDP per capita with the help of a well-stabilized growth model. The authors found that the AIDS epidemic has had an insignificant effect on the growth rate of per capita income, with no evidence of a reverse causality.

Arndt *et al.* (2000) constructed an economy-wide simulation model that embodies the important structural features of the South African economy over the period of 1997-2010. The authors found that the difference between the economic growth rates under the “no-AIDS” and “AIDS” scenarios are substantial; the maximum difference is 2.6%. They examine different ways in which the epidemic can affect economic growth. They find that a shift in the government’s health expenditure is one of the most important ways through which HIV impacts economic growth. This increases the budget deficit and reduces the Total Factor Productivity (TFP).

Cuesta (2008) adopted a Cuddington (1993) type aggregate production function model to test the impact of HIV epidemic on economic growth in Honduras over 2001-2010. The author found that the epidemic can not harm economic growth through either the capital or the labor

channel. The author also found that the set of critical factors that affect economic growth in Africa (human capital reduction, shifts in relative skills, and increase in government health expenditure) are not the same in Honduras. This is an important observation because different factors can play different roles across regions.

SECTION 3

Methodology and Data Source

In this paper, we include the HIV prevalence data for 50 African countries for the five year-period from 2004 to 2009. As we have already pointed out, the use of such a dataset is rare. We use the following model to examine the impact of HIV on the economic growth rate of a country.

$$Growth_Rate = f(HIV\ prevalence, Control\ Variables)$$

We use both fixed and random effects models to estimate the model. Country specific dummy variables are used as controls for cross-country heterogeneity. This is a powerful and widely accepted technique for such a pooled type of datasets.

We use three control variables to represent the macroeconomic environment of each country. These variables are health expenditure per capital, trade openness, and literacy rate. The health expenditure and the literacy rate variables act as controls for socio-economic development of a country as we test the relationship between HIV prevalence and economic growth. The trade openness variables act as controls for economic development of a country.

Most of the data is collected form UNAIDS and the World Bank Global Indictors, 2011. We collect data for 2004 to 2009 for 51 countries in the African Continent. This sample is a pooled dataset. Therefore, this evidence will apply to different countries.

SECTION 4

Empirical Results

In Table 1 and 2, we present summary statistics and correlation coefficient of the key variables. In our case, we have chosen the HIV prevalence rate in the total population (percentage term) as the measure of HIV variables. We want to measure the impact of these variables on the annual growth rate of per capita Gross Domestic Product (GDP). To control the economy, we introduce three controls namely: literacy rate, expenditure on health as a percent of GDP, and openness of the economy (difference between export and import divided by GDP).

In Table 3, we present the fixed and random effect models. We find that there is a negative impact of HIV prevalence rate on economic growth in onlythe fixed-effect model but not in the random-effect model. To solve this vexing question, we conduct theHausman test to choose between the two sets of results. The outcome of this test supports the fixed-effect model. Our evidence shows that “HIV does not affect economic growth” idea does not have empirical support. On the contrary, we document that HIVprevalence has real negative impacts on economic growth. Although we follow a completely new method in testing the relationship (compared to Over (1992) and others), we arrive at the same important conclusion.

Table 4 shows regression results when countries are ranked in order of their economic growth rate. For high-growth rate countries (fast growing countries), we find a statistically significant negative association between HIV prevalence and economic growth. However, this is not the case for low-growth rate countries; we do not find an association of HIV prevalence with economic growth.

Next, we divide the dataset into two sub-samples based on the HIV prevalence: one part is the high-HIV prevalence and the other part is the low-HIV prevalence. We then run an ordinary-least square regression. Table 5 shows the result for this part of the test. We find that, in both cases, the HIV prevalence is not statistically significantly associated with economic growth. In this case, we do not use a fixed effect model with the country dummy. That may explain the results.

In the last step, we create a separate dataset and rank it in the order of per capital income (GDP per capita). Results obtained from that data-set are not reported here. The inverse impact of HIV prevalence on economic growth is re-confirmed. We also find evidence that this is true for countries outside the continent of Africa.

SECTION 5

Conclusion

In this study, we document extensive evidence on the adverse impacts of HIV prevalence on economic growth. This is in-line with some recent studies on the topic (which are different from previous studies that concluded ‘HIV-prevalence/AID-prevalence do not matter’).

The fixed effect panel data method is the most appropriate technique for this type of multiple-country and multi-year pooled datasets. We include 51-countries in this sample, all of which belong to the continent of Africa (this continent is the home to some of the areas affected most by HIV/AIDS). We include the period from 2004 to 2009, which is very recent evidence.

With this evidence in hand, we can safely say that there is an urgent need for intervention to curb and then to reverse the spread of HIV. We recommend that the governments of the host countries, the governments of the donor countries, donor agencies, and non-governmental organizations should all take urgent steps to mitigate the situation. The disease affects people across borders and nationalities. Therefore, a united effort from different countries/organizations is welcome. Partnership between governments, donor agencies, and non-governmental organizations can go a long way in solving the problem.

The importance of education in solving the HIV problem can hardly be overemphasized. This is especially true in poor developing countries, where illiteracy is the norm and not an exception (this is especially true for girls and women). People need to know how they can prevent HIV/AIDS in the first place. Also, modern treatment facilities should be made available to people at low costs. Otherwise, they will not be able to get treatment, and this will pose a risk to the spread of HIV/AIDS in the communities. Governments and donors can take steps to transfer modern prevention and treatment techniques from developed countries to developing countries. Otherwise, it will take a long time for developing countries to acquire those modern

techniques. This will not stop the spread of HIV/AIDS even in cases where it could have been prevented.

Programs to prevent HIV / AIDS should give special attention to younger people and to women; they are the ones at most risk. For instance, a single mother may be under more pressure to involve her on risky behaviors than others. Also, mothers can easily pass on the disease to their unborn children. Poverty and gender can create a 'vicious circle' where the existence of one reinforces the other. Therefore, the task of preventing HIV/AIDS is difficult as it is, but it is even more difficult when we have to take poverty into consideration. The low status of women and higher incidences of poverty among women trigger the spread of HIV/AIDS. Therefore, special attention is needed for poorwomen, or perhaps female headed households.

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STATISTICAL APPENDIX

Table 1
Summary of Statistics

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std.</i>
Growth Rate of GDP	285	0.047577	0.041162
HIV_Prevalence Rate	228	1.319808	0.989977
Literacy Rate	295	55.90169	8.438684
Health Expenditure	285	5.814035	2.292935
Trade Gap as Percent of GDP	285	1268.46	1850.688

Table 2
Correlation Coefficient

	<i>Growth Rate of GDP</i>	<i>HIV_Prevalence Rate</i>	<i>Literacy Rate</i>	<i>Health Expenditure</i>	<i>Trade Gap as Per cent of GDP</i>
Growth Rate of GDP	1				
HIV_Prevalence Rate	-0.0558	1			
Literacy Rate	-0.1909	-0.4024	1		
Health Expenditure	-0.0489	0.1456	-0.159	1	
Trade Gap as Percent of GDP	-0.0179	0.223	0.2367	-0.1981	1

Table 3
Fixed Effect and Random Effect Models

Panel A: Fixed Effect Model

	<i>Coefficient</i>	<i>Standard Deviation</i>	<i>t-test</i>	<i>P-value</i>
Lag of HIV_Prevalence Rate	-0.03256	0.018285	-1.78	0.077
Literacy Rate	-0.01074	0.003007	-3.57	0.000
Health Expenditure	-0.01473	0.003252	-4.53	0.000
Trade Gap as Percent of GDP	4.08E-05	1.73E-05	2.37	0.019
Constant	0.710258	0.160828	4.42	0.000

Panel B: Random Effect Model

	<i>Coefficient</i>	<i>Standard Deviation</i>	<i>t-test</i>	<i>P-value</i>
Lag of HIV_Prevalence Rate	-0.01918	0.021104	-0.91	0.365
Literacy Rate	-0.01062	0.003072	-3.46	0.001
Health Expenditure	-0.01422	0.003257	-4.37	0.000
Trade Gap as Percent of GDP	3.92E-05	1.74E-05	2.25	0.026
Constant	0.68454	0.16697	4.1	0.000

Table 4
Impact of HIV Prevalence on Economic Growth (Level of Economic Growth)

Panel A: The first 100 observations

	<i>Coefficient</i>	<i>Standard Deviation</i>	<i>t-test</i>	<i>P-value</i>
Lag of HIV_Prevalence Rate	0.716826	0.476395	1.5	0.137
Literacy Rate	-0.04124	0.076121	-0.54	0.59
Health Expenditure	0.388347	0.124101	3.13	0.002
Trade Gap as Percent of GDP	0.015394	0.004757	3.24	0.002
Constant	-0.19324	4.606769	-0.04	0.967

Panel B: The 101 to 200 observations

	<i>Coefficient</i>	<i>Standard Deviation</i>	<i>t-test</i>	<i>P-value</i>
Lag of HIV_Prevalence Rate	-0.24159	0.573701	-0.42	0.675
Literacy Rate	-0.09937	0.130068	-0.76	0.447
Health Expenditure	-0.07302	0.281481	-0.26	0.796
Trade Gap as Percent of GDP	-0.00245	0.002232	-1.1	0.275
Constant	12.14495	7.801084	1.56	0.123

Panel C: Observation 200 and to the end

	<i>Coefficient</i>	<i>Standard Deviation</i>	<i>t-test</i>	<i>P-value</i>
Lag of HIV_Prevalence Rate	-2.53435	1.244738	-2.04	0.048
Literacy Rate	-0.36229	0.134322	-2.7	0.01
Health Expenditure	-0.32714	0.501637	-0.65	0.518
Trade Gap as Percent of GDP	-5.6E-05	0.000388	-0.14	0.887
Constant	31.5451	7.405306	4.26	0

Table 5
Impact of HIV Prevalence on Economic Growth (Degree of Prevalence)

Panel A: HIVPrevalence is less than 5% of the Total Population

	<i>Coefficient</i>	<i>Standard Deviation</i>	<i>t-test</i>	<i>P-value</i>
Log of HIV_Prevalence Rate	-0.80057	0.696841	-1.15	0.254
Literacy Rate	-0.01571	0.08159	-0.19	0.848
Health Expenditure	0.157531	0.221915	0.71	0.48
Trade Gap as Percent of GDP	-0.0005	0.000202	-2.48	0.015
Constant	6.908055	4.699391	1.47	0.145

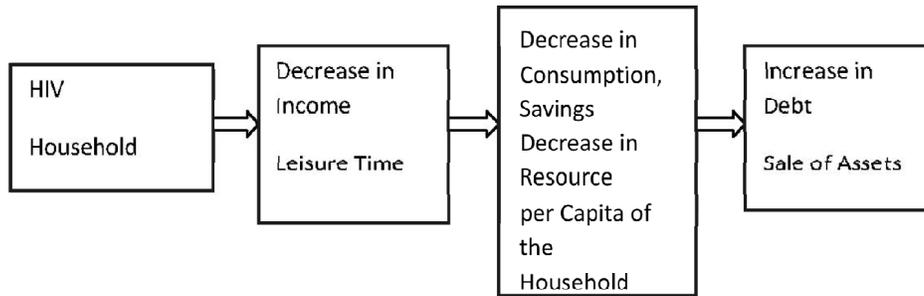
Panel B: HIVPrevalence is more than 5% of the Total Population
(CrisisCountries)

	<i>Coefficient</i>	<i>Standard Deviation</i>	<i>t-test</i>	<i>P-value</i>
Log of HIV_Prevalence Rate	-0.98792	0.680876	-1.45	0.15
Literacy Rate	-0.0246	0.080205	-0.31	0.76
Health Expenditure	0.194801	0.219654	0.89	0.378
Trade Gap as Percent of GDP	-0.00048	0.000197	-2.45	0.016
Constant	7.5441	4.618091	1.63	0.106

Impact of HIV on an Individual Household/Family

Sarker (2011) pointed out the following:

1. Expenses related with treatment of HIV.
2. Loss of income due to sickness if the person is an income-earner.
3. Caregivers also must work less now that they have to look after the sick person;their income will also decrease.
4. Their leisure time will also decrease.
5. This will mean less resource per-capita in family, which will affect basic needs like consumption, food, clothing and other utilities.
6. Fewer resources will be available for educating children.
7. Savings will decrease.
8. Assets may be sold and the family may incur some debts.
9. If there are not enough adult members in the family, students may be withdrawn from school to take up some of household responsibilities.



Major Channels of HIV/AIDS' Impact on the Economy

Arndt *et al.* (2000) pointed out the following

For firms	
Insurance/benefits up	Affects cost, profits, savings
Disruption/absenteeism	Affects overall productivity
Worker experience down/ morbidity	Affects labor productivity
For government	
AIDS spending up	Affects other spending, deficit
Production structure shifts	Affects revenue from VAT, trade taxes
Household income, spending shift	Affects income tax receipts, transfers
For households	
Loss of income/orphans	Vulnerable households require transfers
Caring for HIV/AIDS	Changed expenditure patterns, reduced savings, assets sales, lower investment in human capital
For the macro economy	
Lower physical and human development	Reduced growth trajectory
Class biased impacts	Uneven welfare effects

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

<i>Country</i>	<i>Reference</i>	<i>Average reduction in annual GDP growth rate</i>
India	Anand et al (1999)	0.1-1.0
Cameron	Kambou et al (1992)	1.9
South Africa	Arndt and Lewis (2000)	1.4-2.6
South Africa	BER (2001)	0.1-0.9
South Africa	Quattek (2000)	0.3-0.4
Botswana	BIDPA (2000b)	8 (over 10 years)
Botswana	Jefferis and Grnner (1999)	1-2
Trinidad and Tobago	Nicholls <i>et al.</i> (2000)	4.2 (over 8 years)
Jamaica	Nicholls <i>et al.</i> (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 (2997)	Insignificant
70-80 low and middle income Countries	Bonnel (200b)	1.20 (in case of prevalence of 20 per cent) 0.80 (as in SSA, prevalence 8 %)
41 African countries	Dixon <i>et al.</i> (2001)	1.30 (in case of prevalence of 20 per cent)

Source: Cornia *et al.* (2000) "The HIV and AIDS Impact on the Rural and Urban Economy".

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