

I-Heng Emma Lee  
ihelee@u.washington.edu  
ECON 482 Final Draft  
December 11, 2002

## **A poor man's disease?**

### **Executive Summary**

In this paper, I have investigated the differing causes of HIV/AIDS between developing (defined as African, Asian and South American countries) and developed (defined as North American and Western European) countries. Data was collected from websites and online databases of UNAIDS, WHO and UNESCO. It was found that for developing countries, an increase in gross domestic product lowers the infection rate; while increases in crime, health expenditure, population size and the proportion of the population living in urban areas would increase the number of people infected. Enrollment in primary and secondary education for males helps to decrease the infection rate; however, the opposite is true for females. On the other hand, for developed countries, opposite signs were obtained for gross domestic product, crime, population size and proportion of the population living in urban areas; but there is a similar relationship between health expenditure and the infection rate. The effect of education in this case is unclear.

In addition, there have been no significant structural changes, for similar relationships between the infection rate and the explanatory variables were obtained for earlier periods.

Given the fact that the virus is still relatively young (it was first diagnosed in the early 80's), the amount of data available may be insufficient to generate conclusive results. Furthermore, it may be the case that the really significant variables which cannot easily be quantified, such as an individual's sexual behavior, are really the ones with the greatest influence on the infection rates.

## **Introduction**

In this paper, I am seeking to investigate the differing causes of HIV/AIDS between the developing and poorer countries (defined as African, Asian and South American countries), and the developed and richer countries (defined as North American and Western European countries). In doing so, I am trying to ascertain reasons as to why AIDS has impacted the poorer countries to a greater extent. Based on facts obtained from research and personal knowledge, I have identified the following variables as being possible factors in the spread of the virus: gross domestic product (GDP), as richer countries tend to have fewer worries with epidemics nowadays; crime, on the hypothesis that this could be used as a way of transmitting the virus for example through rape; obviously health expenditure, population growth, for the virus is carried and spread through people; urbanization, often cited as a reason for the growth of the epidemic; education, as it is a way to alter existing behavior. There are other variables which I would have liked to include but could not. For example, although AIDS is most often spread through sexual activity, it is rather difficult to obtain accurate data on this personal topic.

## **The Data**

I had expected the collection of data to be fairly straightforward since I assumed that such statistics should be readily available on the Internet, for just about everything seems to have been converted to electronic format nowadays. Although everything was indeed on the websites, it took a great deal of searching and e-mailing to find the necessary information. Nevertheless, all of the data were still obtained from Internet websites. The number of people infected with HIV or AIDS as well as the population size were taken from the July 2002 epidemic update report issued by UNAIDS, a joint venture between the United Nations (UN) and the World Health Organization (WHO). These two figures were then used to generate the percentage of people infected in the population, so that the size of a country's population in absolute terms would not have a bearing on

its number of infected people. The GDP per capita and the level of health expenditure per capita were taken from country statistics calculated by the WHO and to account for inflation and exchange rate differences, GDP and health expenditure per capita were calculated in international dollar units. An index for stability and violence was obtained from the World Bank online database for growth in order to proxy for the crime rate. The index is between the ranges of  $-2.5$  and  $2.5$  with most of the developing countries receiving relatively lower scores. Population growth rates and percentage of the population residing in urban areas were obtained from WHO epidemiological fact sheets for each country. Finally, measurements for education were taken from United Nations Educational Scientific and Cultural Organization reports. This includes primary and secondary school enrollment rates calculated for males and females separately. I have chosen to distinguish between the genders as females often benefit more from an education in such cases for they are usually the ones who are forced to stay home to care for sick relatives in developing countries. Thus an education grants them a start to financial independence and avoids their having to resort to prostitution for a living as well. In the case of males, it has been proposed that in developed countries the educated males are often the most prolific carriers of the disease as they have the ability and finances to move around. While high school and any further education will no doubt make a difference to a person, their effects are unlikely to be as great as that of primary and secondary schooling for a developing country. It should be noted that many countries originally selected had to be removed from the model due to incomplete data. This is especially true in the case of developing countries, where their lack of HIV/AIDS data for earlier years could be due to a shortage of resources (which could result in misdiagnosis and report delays). Furthermore, the stigma attached to the virus may have resulted in some developing countries being hesitant to greatly publicize the information, as it could have negative impacts on for example, tourism.

## The Model

The regressions I ran were of the form: (standard errors are shown in brackets)

$HIV/AIDS\ infected\ rate = \alpha + \beta(GDP) + \delta(Crime) + \phi(Health\ Expenditure) + \gamma(Population\ Growth) + \eta(Urban\ population) + \lambda_1(Primary\ School\ Enrollment\ for\ Males) + \lambda_2(Primary\ School\ Enrollment\ for\ Females) + \lambda_3(Secondary\ School\ Enrollment\ for\ Males) + \lambda_4(Secondary\ School\ Enrollment\ for\ Females)$

For developing countries:

HIV/AIDS infection rates = -8.681766 - 0.001527(GDP) + 2.471199 (Crime) +  
(11.10402) (0.000701) (1.696081)  
0.477949(Health Expenditure) + 5.312145(Population Growth) + 0.057265(Urban  
(0.549622) (3.651346) (0.048791)  
Population) - 0.133393 (Primary School Enrollment for Males) + 0.138485(Primary  
(0.140633) (0.121447)  
School Enrollment for Females) - 0.085080 (Secondary School Enrollment for Males) +  
(0.236716)  
0.220577(Secondary School Enrollment for Females)  
(0.217475)

The signs show that as predicted an increase in GDP would lower the infection rates, and that crime does indeed contribute to the number of infected. Furthermore, population growth and urbanization also adds to the number of infected. However, the positive coefficient obtained for health expenditure is surprising. This could mean that as governments allocate more to health expenditure, the existent proportion of the population who are already infected will live longer, and thus could have more opportunities to spread the virus. In addition, the amount allocated to health expenditure is used to address all health needs, and not just that resulting from AIDS. Furthermore, many developing countries do not, or simply cannot, afford to devote substantial funds to AIDS prevention and treatment. Many HIV positive patients may also opt to visit traditional healers instead of a physician. These would usually not be included in a country's health expenditure. The coefficients obtained for education are likewise unexpected. It would seem as if higher enrollment is only effective in decreasing the number of infected in the case of males. Although this may be surprising at first, this outcome could be as a result of the way I have chosen to define my countries.

Since males are usually the dominant members in African and Asian societies, then perhaps educating them would be more effective in adjusting behavior. An  $R^2$  of 0.45 was obtained, with only the coefficient of GDP being statistically significant.

For developed countries:

$$\begin{aligned} \text{HIV/AIDS infection rates} = & -0.645960 + 0.000033 (\text{GDP}) - 0.260034 (\text{Crime}) + 0.008268 \\ & \quad (0.496267) \quad (0.0000131) \quad (0.094069) \quad (0.021696) \\ & (\text{Health Expenditure}) - 0.268236 (\text{Population Growth}) - 0.006023 (\text{Urban Population}) + \\ & \quad (0.107371) \quad (0.003421) \\ & 0.046736 (\text{Primary School Enrollment for Males}) - 0.039847 (\text{Primary School Enrollment} \\ & \quad (0.018609) \quad (0.020645) \\ & \text{for Females}) - 0.002003 (\text{Secondary School Enrollment for Males}) + 0.001508 \\ & \quad (0.004330) \quad (0.003070) \\ & (\text{Secondary School Enrollment for Females}) \end{aligned}$$

Here an increase in a country's GDP will actually increase the infection rate, although by very little, while interestingly crime supposedly lowers the number of infected. As in the regression for developing countries, an increase in health expenditure will cause a corresponding rise in the infection rate. However, contrary to the case for developing countries an increase in population growth and the urban population will decrease the number of infected. While these results may seem contradictory, it should be remembered that for most advanced nations, GDP growth has been relatively stable and population growth low. Furthermore, urbanization is not as recent a phenomenon for advanced nations. The coefficients obtained for education are a bit strange. It would imply that males need to reach secondary school while females would only need primary school before education would help to lower the infection rates- highly unlikely in reality. An  $R^2$  of 0.76 was obtained with coefficients for GDP, crime, population growth and primary school enrollment for males being significant.

For both models, White's test for heteroskedascity was run and no corrections were needed. In an attempt to obtain better results, I tried regressing infected rates with each of the variables alone, as well as infected rates with different combinations of the variables. However, I failed to get

any  $R^2$  higher than the original, or any statistically significant coefficients. This would suggest that, as would be expected, that there are relationships between the variables, for many of them would probably trend together and therefore cannot be left out.

I then reran the regressions for previous years (all in the 90's) for which I could find a full set of data. The coefficients obtained are similar to those in my original model. This is reinforced by my Chow Test, where the test statistic I got did not allow me to reject the hypothesis that there have been no structural changes. However, this result may have been different had I been able to find complete data from the 80's, since AIDS had not yet reached crisis proportions then and thus the coefficients would most likely be different as infection rates have been growing at a faster rate than my explanatory variables in most countries. Caution needs to be exercised before using my model to determine infection rates given certain levels of my right hand side variables.

## **Conclusions**

Overall, it would seem as my model does not do that good a job of explaining the data. Perhaps my choice of selecting countries by wealth is inappropriate, or maybe the variables that I predicted as being significant determinants are in actual fact not. For example a more appropriate measure for education might be the number of students who complete their schooling, rather than the number who enroll. Furthermore, it might be the case that the variables which are not strictly quantifiable are really the ones with the greatest influence on infection rates- for example, an individual's viewpoint with regards to promiscuity. Nevertheless, my model does provide some insight as to the varying causes of the virus between developing and developed countries, and their differing needs with regards to policy.