Does Aid Curb AIDS? An Investigation of the Effectiveness of Development Assistance for Health (DAH) on Health Outcomes

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LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
AR	Auto Regression
BMGF	Bill & Melinda Gates Foundation
CSDH	Commission on *Social* Determinants of *Health*
DALY	Disability Adjusted Life Years
DAH	Development Assistance for Health
DPD	Dynamic Panel Data
GBD	Global Burden of Disease
GHE-A	Government Health Expenditure as Agent
GHE-S	Government Health Expenditure as Source
GMM	Generalized Method of Moments
GFATM	Global Fund to Fight AIDS, Tuberculosis and Malaria
HIV	Human Immunodeficiency Virus
IHME	Institute for Health Metrics and Evaluation
OECD	Organization for Economic Co-operation and Development
ODA	Official Development Assistance
PEPFAR	President's Emergency Plan for AIDS Relief
PMTCT	Prevention of Mother-To-Child Transmission

SFI	State Fragility Index
UNAIDS	Joint United Nations Program on HIV/AIDS
UNGAPD	United Nations General Assembly
US	United States
WHO	World Health Organization
YLL	Years of Life Lost
YLD	Years of Life Lived with Disability

ABSTRACT

HIV/AIDS has been one of the hardest hitting epidemics in recent times. Within the past four decades since its discovery, over 78 million people have been infected with some 38 million

related deaths so far. The chronic nature of the disease makes it such that years of significant progress made in reducing viral loads can be reversed within months of a break in medication. Quite unfortunately, the burden of HIV/AIDS has fallen disproportionately on developing countries. The past few decades has seen significant amounts of Development Assistance for Health (DAH) donated to developing countries to combat the virus. Since 2019 however HIV/AIDS DAH has begun to fall with donor governments and agencies urging recipient countries to pull up their weights and fill in the gap. This could not have come at a worse time as Covid 19 pandemic has made most recipient governments cash strapped. Where do we go from here?

Research on the effectiveness of HIV/AIDS DAH has been scant and the few attempts have struggled to holistically model a health production function with a suitable health indicator variable which captures the true burden of HIV/AIDS. Most of the attempts so far rely on new HIV infections and or HIV mortality rates. These variables however paint an incomplete picture of the true burden of the virus in that, it does not take into consideration the number of years the average dead person fell short off the of the average life expectancy nor does it take into consideration the number of years the average person lives with the disease and how it reduces their productivity. Another shortcoming of the few efforts has to do with the presence of comorbidities. HIV/AIDS is notorious for the number of opportunistic diseases and infections that it invites because of the weakness it gives the immune system. Failure to control for the possibility of these diseases severely puts any estimation under question.

To overcome these obstacles, I employ a dynamic health production function inspired by that of Grossman (1972a b). In place of the usual mortality measures I use the more holistic Disability Adjusted Life Years (DALY) of HIV/AIDS which incorporates the average years of life lived with the disease as well as the average years of life expectancy lost to the disease, as my main dependent variable. I control for the presence of comorbidities by employing the DALY for all other diseases except HIV/AIDS. DAH is subsequently divided by channel into bilateral and multilateral channels and together with other social and economic health inputs, I provide suggestive evidence as to how bilateral aid, multilateral aid, government health spending, private health expenditure among other variables affect the burden of HIV/AIDS on a particular recipient country.

Using a panel of 115 countries between the years 1995 and 2017 and employing the System GMM with fixed effects approach, I provide suggestive evidence showing that ceteris paribus, in the short run and at a 95% confidence level, a US $1 increase in multilateral HIV/AIDS DAH per capita resulted in a reduction of about 49 DALY's per 100,000 people among the countries sampled. The evidence did not show any significant effects from bilateral DAH. What is more, domestic government health spending as well as private health expenditure also had insignificant effects on DALY for HIV/AIDS. Demographically, I provide groundbreaking evidence that HIV/AIDS DAH has not significantly reduced the burden of HIV/AIDS on women and children below 14 years. In another novel move, I show that HIV/AIDS DAH works irrespective of the sociopolitical environment. These results are robust against a number of checks including using a different estimation technique, using deeper lags, dropping outliers among others.

Now, the way forward. I recommend donor governments and agencies to exercise caution when pushing domestic governments to pull their weights in HIV/AIDS financing. I also recommend that bilateral donor partners should channel more of their bilateral DAH directly into multilateral channels like that of the UNAIDS, GAVI, UNICEF among others as a dollar spent by these agencies is worth more than two dollars of bilateral DAH spent. More importantly, this extra DAH should be focused on improving the sexual and reproductive health of young women and girls in recipient countries.

CHAPTER ONE

Introduction

The HIV/AIDS pandemic remains one of the deadliest pandemics to have hit the human race in recent times, with 79 million infections and 38 million deaths since its discovery (UNAIDS (2021a)). Being the advanced form of the Human Immunodeficiency virus (HIV), the Acquired Immunodeficiency Syndrome (AIDS) was first recognized as a new disease in 1981 after it was observed that young homosexual men fell to unusual opportunistic infections that should have been curtailed by their immune systems (Sharp and Hahn (2011)). Having its origins in Sub Saharan Africa, the disease has wreaked havoc on the continent and has since spread across the globe, with many of the severely affected countries being developing nations (UNGAPD (2011)).

Globally, the burden of HIV/AIDS disproportionately falls on sub-Saharan Africa, where in 2017, 71% of the people infected resided, 65% of new infections and 75% of HIV/AIDS related deaths occurred (James et al. (2017)). The scale up of access to Anti-Retroviral Treatment (ART) from 2·98 million people in 2006 to 21·8 million in 2017 resulted in a 51% reduction of HIV related mortality (Frank et al (2019)). The combination of such decreases in mortality and a slight decrease in incidence has resulted to an increase in the people living with HIV from 8·74 million in 1990 to 36·82 million in 2017 (Pandey and Galvani (2019)). As of 2020, only 73% of the estimated infected people were receiving treatment (UNAIDS (2021a)). With the largest population of infected people currently alive than ever before and a good chunk of infected people living without any form of treatment, the eradication of the disease is likely to take a bit longer than anticipated. It is therefore not surprising that the UNAIDS 2014 target of globally diagnosing 90% of people living with HIV, provide treatment to 90% of people diagnosed, and achieve viral suppression in 90% of people on treatment by 2020 was missed[1]. As of December 2019, only 14 countries had achieved the target. Globally, an estimated 81% of infected people knew their status and 67% of them were on treatment within the same period (UNAIDS (2020a)).

[1] The UNAIDS in a press release in July 2020, admitted that the 90-90-90 target set in 2014 for the end of 2020 will not be met. Citing unequal achievements between and within countries as the reason for missing these targets (UNAIDS (2020 b)). The goal of these targets was to ensure that at least 73% of people living with HIV/AIDS will have suppressed viral loads.

Crucial to the battle against the epidemic is its financing. In the year 2000, 135 low and middle income countries (accounting for 94% of global incidence and 98% of global deaths) spent a total of United States (US) $ 4.3 billion in combatting HIV/AIDS[2]. This figure grew at an annualized rate of 9.62% to reach US $20.2 billion in 2017 (Micah et al. (2020)). Dieleman et al. (2018) estimated that between the years 2000 and 2015, a total of US $ 563 billion had been spent globally on HIV/AIDS of which 58% was financed by governments. The scale of mobilization of funds to combat HIV/AIDS over the years has been unprecedented. The world was presented with a huge task of finding sufficient funds to supplement the costs of treatment, prevention and care in middle and low income countries. Mobilization of these funds has since been characterized by strong advocacy, novel funding techniques, previously unseen levels of bilateral aid and multilateral donations from private and non-governmental organizations on a scale rivalling that of governments (Avert, (2021)). Paramount in this collective effort is the contribution from Development Assistance for Health (DAH). Because the burden of the virus fell predominantly on low and middle income countries, funds to combat the epidemic in most of these countries had to come from DAH (UNAIDS (2021b)). In 2019 alone, donor governments accounted for approximately 39% of the estimated $19.8 billion total expenditure on HIV/AIDS (29% of which was given bilaterally (directly) and 10% via other agencies) (Kates et al. (2020))[3]. The United States remains by far, the single largest donor. Through its President's Emergency Plan for AIDS Relief (PEPFAR), about US $ 85 billion has been given either bilaterally or via other agencies in the global AIDS response (PEPFAR (2021)). Since 2017, however, increases in DAH to combat HIV/AIDS has stalled and began to decline in 2019 by some US $165 million compared to that of 2018 .This is primarily because most donors have been scaling down on their efforts for a while now. But for funding from the U.S., contributions from other donor governments towards the fight against the virus would have declined by more than $1 billion since 2010, from US$3.2 billion to US$2.1 billion (Kates et al. (2020))[4].

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[2] This included $ 2.3 billion from domestic government spending, $ 550 million from Development Assistance for Health (DAH) and $ 480 million out of pocket spending (Micah et al., 2020).

[3] Of the US $19.8 spent on the virus in 2019, 57% came from domestic government expenditure (Kates et al. (2020)).

[4] In April 2021, the government of the United Kingdom made international headlines when it announced an 83% reduction in its yearly assistance in the fight against the virus it gives through UNAIDS, UNAIDS (2021c).

Statement of the Problem

A number of factors are brewing and could possibly combine to create a perfect storm-like situation which might erode all the gains that have been made in the past three decades in the fight against the virus. First of all, the number of new infections remain high[5] .What is more, there are more people living with HIV/AIDS now than ever before and a good chunk of them are living without any treatment and hence have dangerous levels of viral loads (UNAIDS (2021a)). The COVID-19 pandemic has also dealt a blow to the fight against HIV. According to The Global Fund (2021a), lockdowns across the globe has led to the stoppage of many HIV related programs in affected countries. In certain cases infected persons can no longer access their periodic ART to keep their viral loads in check. The COVID-19 pandemic has also starved the fight against HIV/AIDS off much needed funds as governments in most developing countries lose much revenue and have to divert a lot of funds to curb the COVID-19 pandemic. This can be detrimental to the gains chalked so far. According to UNAIDS (2021a), a half year complete disruption in HIV treatment could result in 500 000 more deaths in sub-Saharan Africa within a year, bringing the region back to 2008 AIDS mortality levels. Finally, much needed DAH from advanced countries have been on a decline since 2019. Even though sources like that from multilateral agencies, private donations and that of domestic governments have been on a rise, there is still a gap in financing this global health crisis. Per estimates from UNAIDS (2020 a), there was a 17% gap in the global budget to contain HIV/AIDS for the 2020 financial year.

The claims as to how various forms of DAH can and has helped over the years is based on the assumption that first of all, DAH combined with local government spending is effective in reducing the burden of disease in all settings, other things being equal. Indeed various organizations have made similar bold claims as to how their financial interventions have helped reduce the spread, improve the life span and reduced the number of deaths resulting from infections from HIV/AIDS and its attendant opportunistic infections. The PEPFAR, one of the US

[5] According to (UNAIDS 2020a), there were 1.7 million newly infected people in 2019. Infection rates in eastern Europe and central Asia have jumped by 72% since 2010. 62% of new infections globally occurred among key populations and their sexual partners like homosexuals (men), sex workers, prisoners and drug users. In sub Saharan Africa, it was estimated that, 4500 young women between the ages of 15 and 24 were infected every week.

government's main agencies in the global fight against the virus asserts that since its inception in 2003, some US $ 85 billion has been spent and has resulted in saving 20 million lives PEPFAR (2021). The Global Fund to fight AIDS Tuberculosis and Malaria (GFATM), the largest multilateral donor in the fight against the virus (Nunnenkamp and Öhler, (2011)), also makes a similar claim that their interventions in their special focus countries have helped reduced HIV related deaths by 65 % (The Global Fund (2021b)). So far, as far as my efforts could go, there are not many research works to have empirically tested these claims with data going back into the late 20th century where global financial mobilizations to curtail the virus began. Nunnenkamp and Öhler (2011, p.1705) puts it this way "The scarcity of empirical evaluations of the effectiveness of Official Development Assistance (ODA) in containing HIV/AIDS is surprising". These scenes described so far begs a lot of questions. Is there going to be a perfect storm for an HIV/AIDS epidemic resurgence? , If yes, is the global community prepared for it? Is DAH one of the cures? The dearth in empirically testing some of these questions has certainly not been helpful. Therefore the foremost objective of this study is to help fill in the blanks that exist in health aid effectiveness literature by focusing primarily on HIV/AIDS.

Objectives of the Study

With nearly 2 million new infections yearly, the fight against HIV/AIDS looks far from over. Unfortunately the gap in financing the fight against the virus seems to be getting wider by the years as donors begin to cut back gradually on their contributions (mostly bilateral), and are urging the most affected countries to pull their weight, by financing their own responses and to find more efficient and cost effective ways to do so (Avert (2021)).

In the presence of this donor fatigue, it is the aim of this work to point out whether or not more aid rather than less is better in the battle against HIV/AIDS. With the aid of data running back to 1995 up until 2017 this paper seeks to find out by providing suggestive evidence whether aid (both bilateral and multilateral) given over the years significantly reduced the burden of HIV/AIDS on recipient countries. What is more, the paper seeks to find the effects domestic government health spending has on the burden of HIV/AIDS, and whether caution should be exercised when asking developing countries to spend more as a substitute to decreasing donor funding. Another objective of the paper is to find out whether there has been a heterogeneous effect of HIV/AIDS DAH on demography (women and children) as well as classes of countries (Stable, Fragile, Democratic and Undemocratic).

Specifically, I examine the effects bilateral and multilateral HIV/AIDS DAH given within the said period has had on the burden of HIV/AIDS among 115 recipient nations. The burden of HIV/AIDS, the main dependent variable is represented by the Disability Adjusted Life Years (DALY)[6]. Using a Dynamic Panel Model inspired by the health production model from Grossman (1972a)[7], I employ the two step Systems Generalized Method of Moments (GMM) developed by Blundell and Bond (1998) to estimate the effects of bilateral and multilateral aid on the burden of HIV/AIDS since it proposes a clear-cut remedy to the endogeneity problem that has bedeviled the aid effectiveness literature.

The findings of the paper is as follows: the evidence from the findings suggest that only multilateral HIV/AIDS DAH given within the sampling period was significantly effective in reducing the burden of HIV/AIDS among the sampled recipient countries ceteris paribus while bilateral HIV/AIDS DAH was not. Such that, at a 95% confidence level, a US $1 increase in multilateral HIV/AIDS DAH per capita resulted in the reduction of the total burden of HIV/AIDS by 49 DALY's per 100,000 people, ceteris paribus. This implies the amount of years people lived with disability and the years lost as a result of HIV/AIDS fell by a combined 49 years per 100,000 people. It was also discovered that demographically, bilateral and multilateral aid were both not significantly effective in reducing the burden of HIV/AIDS among females of all ages as well as children below the age of 14, in the countries sampled. The evidence given also suggested that HIV/AIDS DAH does not affect different classes of countries (Stable, Unstable, Democratic and Undemocratic) differently. These results were tested against a number of robustness checks including replacing the two step System with the one step System GMM, using deeper lags, factorizing the instrument set (employing the Principal Component Analysis (pca option)) as well as dropping outlying countries.

[6] Disability Adjusted Life Years (DALY) is a utility based measure which quantifies the burden of a particular disease in terms of the number of years lost as a result of death or bad health

[7] In the seminal Grossman (1972a, b) model, the production function for health is evaluated at the micro level. The model in this work will be looked at from the macro or cross country perspective.

Research Questions

In line with the objectives of this paper, the following questions are raised:

1. What is the relationship between HIV/AIDS Development Assistance for Health and the burden of HIV/AIDS on recipient countries?
2. How effective are both Bilateral Aid and Multilateral Aid in significantly reducing the burden of HIV/AIDS
3. Does HIV/AIDS Development Assistance for Health affect vulnerable groups (i.e. Women and children) differently?
4. Does HIV/AIDS Development Assistance for Health affect Stable, Unstable, Democratic and Undemocratic nations differently?

Research Hypothesis

In line with the objectives and questions raised so far the following hypothesis are generated

1. There is a significantly negative effect of both Bilateral and Multilateral aid on the burden of HIV/AIDS, with Multilateral HIV/AIDS DAH causing more reduction than Bilateral HIV/AIDS DAH.
2. HIV/AIDS DAH does not reduce the burden of HIV/AIDS of different sex and age groups in the same manner.
3. HIV/AIDS DAH affects the burden of disease for different classes of countries differently.

Significance of this Study

The main contribution of this paper is to present a comprehensive cross country evidence on the impacts of HIV/AIDS DAH on the burden of disease of recipient countries. Considering the quantum of funds that have gone into the fight against HIV/AIDS in the past few decades, the amount of empirical works on its effectiveness is truly surprising as Nunnenkamp and Öhler (2011) puts it. This is a timely effort to add one more voice (backed with empirical evidence) to the debate calling for the international donor community to exercise caution and a sense of urgency in dealing with HIV/AIDS funding cuts. The incurable nature of the virus means that already infected people have to be put on a lifetime periodic ART in an unabated manner, to keep their viral loads low and to sustain the vulnerable immune system from being attacked by other opportunistic infections like Tuberculosis, Hepatitis B and C , cervical and some genital cancers etc. A brief stop in this treatment can be detrimental. This also makes the gains made in the global fight against HIV/AIDS highly reversible. According to UNAIDS (2021a), sub-Saharan Africa could be back to 2008 AIDS mortality levels with a half year complete disruption in HIV treatment. With the gap in the funding for HIV/AIDS increasing, it is right for policy makers to make informed decisions based on empirical evidence, evidence that has been lacking in this particular field. The level of urgency for research works like these as the funding gaps in this global battle increases cannot be overstated. Some conditions that can combine to create a perfect storm of another wave of HIV/AIDS are all very much ready and available as has been described earlier and it may be only a matter of time if the necessary steps are not taken. This paper is therefore one of the many wake up calls presenting empirical evidence to the international community to help make informed decisions in the fight against HIV/AIDS.

Finally, having looked at aid effectiveness from a more granular level below that of the more ambiguous (in terms of results from past studies) but popular aggregate ODA- growth literature, this paper adds more clarity to the health aid effectiveness literature and the entire aggregate aid effectiveness literature as a whole. Considering the fact that donors insist on the multidimensionality of their objectives such efforts is in the right direction (Dreher et al. (2008) and Nunnenkamp and Öhler (2011)).

Scope and Limitations of the study

The study is a cross country analysis of the effects of DAH on the burden of HIV/AIDS (using DALY). DAH is disaggregated into Bilateral and Multilateral sources. Also percentage of sexually active population (represented by percentage of the population between 15 and 49), Female contraception prevalence rate, Government health expenditure, Personal income, Level of insecurity (a measure of how stable and secure the country is politically) and the Percentage of urban population are all controlled for.

The study employs a Dynamic Panel Data (DPD) model with fixed effects and is estimated using the two step System Generalized Method of Moments (GMM) approach on a sample of 115 countries between the years 1995 and 2017. The 115 countries were chosen out of the sample of all countries that had received some form of DAH and had enough data for all the other variables used in the study. The time frame was limited to begin from 1995 because of the data limitations of some of the variables, specifically the government health expenditure variable which only began from 1995 per the IHME data used.

The system Generalized Method of Moments (GMM) approach is used to deal with the possible endogeneity of DAH to the burden of disease. The data on the variables used are cleaned and collated using the Pandas library from Python programming language and then statistical analysis done with Stata 16 statistical package. The Instrumental Variable method could have been used to cure the endogeneity issues related with DAH but was overlooked due to the unavailability of suitable instruments. This may present as a limitation of the study.

Organization of the Study

The study is therefore divided into five main chapters. The first chapter lays the foundations of the study by explaining the problem that birthed the idea for this study, the study's objectives, its significance among others. Chapter two looks at the relevant literature in and around the topic of the study. Here, I look at the relevant literature on a topic by topic basis. Some of the topics whose literature were discussed are the demand for health model, its development over the years, various inputs that feature in this model etc. I also discuss various measures of health outcome variables employed so far, history and effectiveness of DAH among others. Chapter three discusses the Model to be used in estimation, the data employed and how and where it was obtained as well as the estimation techniques to be used to analyze the data gathered. In chapter four, I discuss my results and findings, I also test the robustness of my model and its results against a number of specification changes, dropping certain variables and countries among others. The final chapter summarizes the entire study, make possible policy recommendations and also directions for future studies.

CHAPTER TWO

Literature Review

Health as an Investment good

The classification of health as a form of human capital in which investments can be made in has been in the circle of economics for a while now. Some of the earliest to touch on this topic was that of Mushkin (1962). Mushkin (1962) in comparing the similarities between health and education capital investment posited that ‘’The concept of human capital formation through both education and health services rests on the twin notions that people as productive agents are improved by investment in these services and that the outlays made yield a continuing return in the future. Health services like education, become a part of the individual, a part of his effectiveness in the field and factory. The future increase in labor product resulting from education or from health programs and be quantified to an extent useful for programming purposes” (Mushkin (1962 pg. 130)).

Demand for Health Models

Galama and Van Kippersluis (2013) acknowledge Grossman (1972a, b) seminal work of health capital model as the “workhorse” model in the field of health economics considering its far reaching contributions. Schneider-Kamp (2020) suggest that Grossman (1972a) built on the efforts of the likes of Mushkin (1962) and introduced the term “Health Capital” in his demand for health model. Unlike Mushkin (1962), his model identifies health capital as both investment good (a good which creates healthy time from which agents can use to work or enjoy leisure)[8] and as a consumption good which economic agents seek because of the pleasure it gives (subject to a budget constraint). Grossman (1972a, b, 2000) in his demand for health models, posits that individuals gain direct utility from both health and consumption. Health depreciates with age (time) and this depreciation can be reduced with investments like exercises, medical costs and education (which he argues increases the efficiency of health investment). Another important determinant of health in his model was an initial endowment of health. The health acquired (in

[8] Grossman referring to health as a capital good means that based on its initial stock, health can appreciate and depreciate over time.

the form of healthy time) can then be used in the production of assets. He comes to the conclusion that, optimal levels of investment in health production will only be achieved when the marginal cost of producing health equals the marginal benefit that accrue from improved health in the form of healthy time (Hartwig and Sturm (2018)) [9].

Health Capital and its relationship with other variables

Several studies have since explored the links between health capital and its investments and a number of variables. Grossman (1972a) suggests that health investment leads to the creation of more healthy hours which can be used in production thereby increasing earnings, other things being equal. Thus drawing a link between health and personal wealth. On the aggregate level, a number of studies have looked at effects healthy populations have on economic growth in general, labor productivity as well as per capita income. Cervellati and Sunde (2011) finds a positive relationship between life expectancy and economic growth[10], Aghion et al. (2010) also find a negative relationship between mortality rates (among the population 40 years and below) and productivity. Acemoglu and Johnson (2007) find no significant effect of large increases in life expectancy on income per capita. Ashraf et al. (2008) observe a modest positive relationship between life expectancy and economic performance. Very early on, Wagstaff (1986) discovered a positive relation between human capital and growth. Conversely, a number of research has also focused on the impacts of increases in per capita incomes or health spending on health outcomes. Gallet and Doucouliagos (2017) refer to it as the spending elasticity[11]. Caliskan (2009) looked at the impacts private and public pharmaceutical expenditures have on life expectancy in 21 OECD countries. It is observed that on the aggregate pharmaceutical expenditure had a positive impact on life expectancy. This effect was however different for males and females as well as for different age groups. Another critical finding was that there was no difference in the effectiveness of public and private health spending on life expectancy. In terms of the gender

[9] Grossman (1972 a,b) assumes a constant relationship between investments in health and health outcomes

[10] Cervellati and Sunde (2011) confirms a non-monotonic relationship between life expectancy and income per capita and the positive relationship between the two is only exhibited after the onset of a demographic transition.

[11] They define Spending Elasticity as the ratio of the percentage change in health outcome to the percentage change in healthcare spending , Gallet and Doucouliagos (2017 p1)

distribution of spending elasticity, Gallet and Doucouliagos (2017) report that the results from various papers remain divided. In their meta regression analysis of the literature within the space, they find that; Ivaschenko (2005) observes a higher spending elasticity of public health expenditure on longevity (a measure of life expectancy) of females than males. Crémieux et al (1999) finds the converse to be true in a similar study. Nixon and Ulmann (2006) also finds no significant differences between both sexes.

Other studies have looked at the nature of health spending as income changes. Baltagi et al. (2017) and Baltagi and Moscone (2010) studied the income elasticity of healthcare and finds that health spending increased less than increases in income hence making healthcare spending a necessity with an elasticity much smaller than in previous studies. Using data from 31 OECD countries Lago-Peñas et al. (2013) find that the long run income elasticity of health to be close to unitary.

Health Production Function and various inputs

In analyzing the effects that various inputs have on individual and aggregate health outcomes, a number of studies have employed a health production function of one shape or the other in the process. Wibowo and Tisdell (1992) suggest that health production functions are used to describe the effects a combination of health inputs have on a specified health output thereby showing how the specified output changes as the inputs change. The dependent variable usually a health status indicator, is crucial to the production function. Some of the frequently used health status indicators include Life expectancy at birth (Cervellati and Sunde (2011), Bayati et al. (2013), Salami et al. (2019)), mortality measures like infant mortality, maternal mortality, cause specific mortality measures relating to diseases like HIV/AIDS, malaria etc (Fayissa and Trajan (2013) , Ogunleye (2011), Gyimah-Brempong (2015)). Some nutritional measures have also been employed, some of these measures include measures of height and weight (Body Mass Index) (Chakrabarti et al. (2020), Manley (2013)). Some popular measures of morbidity also include number of sick days, prevalence rate of specific diseases (Cohen et al. (2015), Bishai and O'Neil (2012)). These measures do have their own shortcomings and criticisms levelled against them are very much publicized. Some of the fundamental shortcomings attributed to the measures of morbidity and mortality have to do with the reliability and scope of civil registration and vital statistics systems in less developed countries. Setel et al. (2007) suggests that most people in Africa and east Asia are born and die without any official statistic essentially rendering them invincible. An assessment by Mikkelsen et al. (2015) revealed that between the years 2000 and 2015 percentage of deaths that was registered only increased from 36% to 38% globally. Another major setback of morbidity and mortality measures is their inability to capture fatal and non-fatal outcomes as well as giving a picture of the severity of each reported case (as all deaths may count as the same). This inhibits comparison among the infected, comparison between different causes (or diseases) as well as a cross-country comparison.

Utility based Health outcome Indicators (DALY)

In the early 1990's there was the desire to shift from mortality and morbidity and develop a single health metric, that permits the comparison of the burden of different diseases, help to set priorities and targets and also evaluate the cost effectiveness of various health interventions. The Global Burden of Disease concept, specifically the Disability Adjusted Life Years (DALY) has since been used by the World Health Organization (WHO) for its reporting on health information (Stein et al. (2007)). DALY is the sum of years of life lost due to premature death (from a particular cause) and years lived with disability in that condition. At the aggregate level for a particular disease and country, this is done by incorporating the number of deaths from a particular cause, the population average remaining life expectancy at the age of death from that cause, the number of new incident cases, the average duration of disability from that disease and the disability weight of that disease (Chen et al. (2015))[12]. In this study DALY will be used as the main dependent variable, as I look at how DAH for HIV/AIDS impacts it. As far as my search could go, there is no paper that considers DAH as a determinant of DALY among the papers that employ it as a dependent variable. Bermudez-Tamayo et al. (2008) looked at how variables like vital state, sex, age at the time of diagnosis, age at the time of death, transmission category, province of residence, AIDS-indicator disease and the period of diagnosis affects the burden of HIV among a

[12] Disability weights are derived using pairwise comparisons in a population-based survey after the previously used method of person tradeoff exercises among panels of medical experts was scrapped. In a form of a discrete choice experiment, respondents are asked to choose between two different states of health. The disability weights are then derived using probit regression analyses based on the frequency of each response Salomon (2010).

sample of 8800 respondents between the years 1983 and 2004. They observe that higher levels of DALY was associated with intravenous drug users, the province of residence and older age at the time of diagnosis. Traebert et al. (2018) also use DALY as a dependent variable in analyzing the burden of HIV/AIDS over a 35 year period in Brazil. The study showed that the increase in the burden of HIV/AIDS was extremely high between 1980 and 1988 followed by moderate increases between 1989 and 1994 and then a trend reversal post 1995.

Economic and Social Determinants of Health

In terms of the determinants of health outcomes, a number of economic, social and environmental factors have been employed in the literature. Of the economic inputs personal income, price of medical services, government health expenditure feature mostly. Cohen et al. (2015) sums up the economic inputs and proxies them with per capita income, Gyimah-Brempong (2015) uses per capita income (proxy for personal income) and domestic government health expenditure. In looking at the effects of aid on health outcomes a number of studies have also incorporated measures of aid into their models. Gyimah-Brempong (2015) included DAH per capita, Gross Domestic Product (GDP) per capita, domestic health expenditure as the main economic inputs, Mishra and Newhouse (2009) also included measures of per capita DAH and income per capita. Afridi and Ventelou (2013) in their model included per capita aid channeled through government sector, per capita aid channeled through the private sector, per capita government health expenditure and per capita private health expenditure.

A lot of social inputs may go into determining health indicators. Braveman and Gottlieb (2014) suggest that, over the past two decades considerable amount of evidence has accrued pointing to the role of powerful social factors excluding medical care that is shaping health of different groups of people. This led the World Health Organization to set up the Commission on Social Determinants of Health (CSDH) with the primary task of promoting evidence based policies and practices that ensures health equity among all social groups WHO (2008). The CSDH defines social determinants of health as structural determinants and conditions of daily life responsible for a major part of health inequities between and within countries. They include the distribution of power, income, goods and services, and the circumstances of people’s lives, such as their access to healthcare, schools and education, their conditions of work and leisure, and the state of their housing and environment. The term “social determinants” is thus shorthand for the social, political, economic and cultural factors that greatly affect health status (WHO (2009 pg1)). Within the literature Gyimah-Brempong (2015) control for government effectiveness and levels of education. Salami et al. (2019) also control for food availability (using food production per capita), access to water and sanitation as well as education (using mean years of schooling) all as possible social determinants of health.

Chronicles of ODA and DAH

Over the past three decades DAH has gained an increased focus from donor nations as well as other international developmental agencies. Within that period DAH has grown increasingly more prominent in the Official Development Assistance (ODA) portfolios of many of these nations and agencies. According to IHME (2011) as cited in Martinez-Alvarez and Acharya (2012), since the early ninety’s ODA as a whole took a turn from infrastructure and other “hard” sectors to a more “soft” and social sector centered. The IHME (2016) as cited in Moon and Omole (2017) estimate that, DAH in 1990 doubled from US $ 6.9 billion to $11.6 billion in the year 2000 and then tripling to US $ 33.9 billion in 2010, as a share of total ODA, DAH grew from 2% in 1990 to 17% in 2014[13]. In the face of such increases in DAH, it is not surprising that effectiveness of DAH has been one of the dominant discourses in the health aid literature. Gyimah-Brempong (2015) classifies the literature on effectiveness of aid on health into macro and micro subsections, where in the macro subsection researchers looked at the effectiveness of ODA on some health outcomes as an offshoot of the aggregate aid effectiveness literature. At the micro level is where researchers looked at the effectiveness of DAH on some health outcomes, specific diseases and or on specific projects like HIV/AIDS or on the US governments PEPFAR initiative. Per his classification, this study will belong to the micro subsection of the health aid effectiveness spectrum. Much like the general aggregate aid effectiveness literature, there is no consensus regarding the effectiveness of aggregate aid on the health sector as well as that of DAH on specific

[13] Martinez-Alvarez and Acharya (2012) attributes the sharp rise in DAH to the urgency and prominence that was attached to HIV/AIDS as an existential threat to global health. According to them HIV/AIDS aid as a proportion of total DAH rose from 10 % to 40 % between the years 2000 and 2007.

health outcomes or projects, as several studies employing different methods come to different conclusions (Gyimah-Brempong (2015)).

Effects of ODA and DAH on Health Outcomes

In studying the long run effects of aggregate aid, one of the many variables Arndt et al. (2015) looked at was infant mortality. It was observed that aggregate aid given between 1970 and 2007 significantly reduced infant mortality rates among other measures. Using the Ordinary Least Square (OLS) approach on a longitudinal panel data consisting of 183 countries, Winkleman and Adams (2017) examined the effects ODA has on reducing infant mortality. It was observed that on the aggregate sample, ODA significantly reduced child mortality between the years 2000 and 2015 and that the effect was strongest among middle income countries. In a systematic review, Taylor et al. (2013) analyzed the impact of ODA in achieving the objectives under the Millennium Development Goal (MDG) 5 concerning maternal mortality. They observe that ODA appear to be associated with small improvements in the MDG 5 indicator. Some studies have observed insignificant impact of ODA on some health indicators. Mishra and Newhouse (2009) looks at both the effects ODA and DAH has on infant mortality on a sample of 118 countries. Using both system GMM and OLS approaches it was observed that ODA had an insignificant effect on infant mortality while the opposite was true for DAH.

Looking at the strand that focuses on the effects of DAH on health outcomes, Feeny and Ouattara (2013) looked at the effects of DAH on child inoculation and found that between 1990 and 2005 there was a significant positive effect of DAH on the inoculation of children. Using the system GMM approach Afridi and Ventelou (2013) looked at the effects of both bilateral and multilateral DAH has on adult mortality. It was observed that both forms of DAH significantly reduced mortality between the years 1995 and 2006. Some recent works that found significant positive effects of DAH include Doucouliagos et al. (2021) using the instrumental variables approach, Pickbourn and Ndikumana (2019) also using the instrumental variables. A few of the papers also find an insignificant effect of DAH on various health outcomes. Mukherjee and Kizhakethalackal (2013), Wilson (2011) both find insignificant effects of DAH on infant mortality and mortality respectively.

In terms of the effectiveness of DAH on specific diseases and health programs, Jemiluyi et al. (2021) suggest that there appears to be a near consensus that DAH disbursed for specific diseases and programs is effective, Nunnenkamp and Öhler (2011) argues on the other hand that generalized statements on the effectiveness of DAH is unwarranted and that the effects varies considerably with the health indicator used as well as the source of the DAH. For HIV/AIDS alone there has been a number of research works done. Nunnenkamp and Öhler (2011) use the Difference in Differences approach to evaluate the effect of a sudden increase in DAH for HIV/AIDS due to the introduction of the US government's PEPFAR program and the Global Fund in the early 2000's. The results obtained was a mixed one, it was observed that DAH was not significant in reducing the number of new infections but was significant in the reduction of HIV/AIDS related deaths. Hsiao and Emdin (2015) find that between the years 1990 and 2010 and on a sample of 120 countries, DAH specifically targeted to combat HIV/AIDS reduced HIV/AIDS mortality same applies to malaria DAH but not DAH for tuberculosis. In looking at the effects of some DAH initiatives or programs on improving health outcomes, Bendavid et al (2012) studies the impacts the United States PEPFAR program has on adult mortality in 27 countries the program operated in. Using personal level data and the Difference in Differences approach the study looked at cross country and within country analyses of all cause adult mortality. It was observed that, all-cause mortality declined more in the 9 special focus countries than the 18 non special focus countries within the sample.

Fungibility of DAH

Following the discourse on aid effectiveness closely is the literature that looks at the possibility that DAH may or may not be fungible. This is not be surprising considering the sharp rise in DAH as a percentage of ODA in the fast few decades. The paper that may have generated the most reactions in this space as suggested by Van de Sijpe (2013) is that of Lu et al. (2010). They successfully segregated government spending at source (i.e. domestic government spending coming strictly from government coffers) and government spending as an agent (entire government spending which may include DAH) by deducting DAH disbursed from government spending as an agent, and tested to what extent government spending at source reacts to changes in Gross Domestic Product (GDP), government size, HIV prevalence, debt and most importantly DAH to government and DAH given through non-governmental agencies. Lu et al. (2010) find significant fungibility in both the short and long run for DAH given to government, and that DAH from non-governmental agencies had a positive impact on government spending at source. Van de Sijpe (2013) made a subsequent re-evaluation of the results from Lu et al. (2010). The point of contention between the two papers seems to stem from how Lu et al. (2010) treated on and off budget aid (or as Lu et al. (2010) puts it DAH to governmental and non-governmental sectors). Van de Sijpe (2013) suggests that the high fungibility estimates Lu et al. (2010) had may be as a result of this classification. Subsequent reevaluating Lu et al. (2010) results using his approach resulted in limited displacement of recipient government health expenditure by DAH.

Dieleman et al. (2013) provided more clarification on Lu et al. (2010) methods as a rebuttal to Van de Sijpe (2013) by extending the data by 4 more years and 23 extra countries. They argue that Van de Sijpe (2013) submission represents a misunderstanding of the construction of Lu et al. (2010) data. Dieleman et al. (2013) clarifies that the data from the IHME used by Lu et al. (2010) sufficiently disaggregates on and off budget aid. In essence Van de Sijpe (2013) on and off budget aid is just a different name for the same disaggregation technique used by Lu et al. (2010). The results obtained by Dieleman et al. (2013) represents a robust negative effect of DAH given directly to government on government health spending at source. Not many studies have looked at the fungibility of HIV/AIDS DAH on domestic government health spending. Harper (2012) suggests that HIV/AIDS DAH fungibility may occur in two different forms. Firstly, governments intended spending on HIV/AIDS may be diverted from HIV/AIDS to other diseases all within the same health sector leaving aggregate domestic health spending unchanged. On the other hand, in anticipation of incoming DAH, governments may divert HIV/AIDS spending to a different sector of the economy all together. This leads to a fall in government health spending. Harper (2012) finds that on the cross country level, HIV/AIDS DAH is not fungible, however a heterogeneous breakdown of the sample reveals the presence of fungibility among the highest recipients of HIV/AIDS DAH.

AIDS Exceptionalism

Another topic in the economics of HIV/AIDS literature is whether or not the disease must be treated differently than other global health issues. In other words does the epidemic deserve all the attention and focus it has garnered from donors and the global health community? This debate is sometimes referred to as the AIDS exceptionalism. Smith and Whiteside (2010 p1), describe aids exceptionalism as “the idea that the disease requires a response above and beyond normal health interventions” (Smith and Whiteside (2010 p1)). In his personal review directly addressing the UNAIDS, England (2008) suggests that “The foundations of exceptionalism were laid when the “rights” arguments of gay men succeeded in making HIV a special case that demanded confidentiality and informed consent and discouraged routine testing and tracing of contacts, contrary to proved experience in public health. It grew to encompass HIV as a disease of poverty, a developmental catastrophe, and an emergency demanding special measures, requiring multisectoral interventions beyond the leadership of the World Health Organization, with its own agency, HIV has been treated like an economic sector rather than a disease” England (2008 p1).

Crowding Out Effects of HIV/AIDS DAH

A number of studies have tried to empirically verify, whether or not HIV/AIDS has received more funding than it deserves and whether there has been a crowding out of aid to other sectors. Shiffman (2008), looked at the aid data between 1992 and 2005 for HIV/AIDS, population aid, health sector development and infectious disease control to analyze if indeed HIV/AIDS funding has displaced funds from these 3 key health areas (i.e. population, health sector development and infectious disease control). He finds that compared to the three health areas, the increments in HIV/AIDS DAH was considerably higher and concludes that even though a crowding out effect may exist its overall effect is reduced by a corresponding increase in global health aid. Similar efforts from Shiffman et al (2009) also reveal that the possibility of crowding out by HIV/AIDS from (population control aid, health sector development and infectious disease control) is not even. They observe that HIV/AIDS may have caused aid for population control and health systems strengthening to stagnate but on the other hand may also have caused aid for other infectious diseases to increase albeit at a slower rate than that of HIV/AIDS itself. Lordan (2011) looked at the possibility of the increases in HIV/AIDS DAH displacing funding away from Malaria, Tuberculosis and the health sector strengthening. It was observed that HIV/AIDS DAH did not displace funding for Tuberculosis but there was substantial crowding out of aid funds from malaria and health sector strengthening.

Contributions of this study to the extension of the knowledge frontier

From the literature discussed so far the closest in terms of purpose and or methodology to mine is that of Nunnenkamp and Öhler (2011) and Hsiao and Emdin (2015). They both look at the impacts HIV/AIDS DAH had on HIV related health outcomes. Nunnenkamp and Öhler (2011) employs the Difference in Differences approach while Hsiao and Emdin (2015) uses the Ordinary Least Square with fixed effects and the GMM model as a sensitivity check. They both find significant effects of HIV/AIDS DAH on mortality. My study is an improvement on these in the following respects. First of all, the dependent variables used (New HIV infections, and HIV/AIDS mortality by Nunnenkamp and Öhler (2011) and HIV mortality by Hsiao and Emdin (2015)) do not give a true picture of the burden of HIV/AIDS. Just like other mortality and morbidity measures, they only paint a binary picture of a particular disease where the respondent is either sick (infected/morbid) or dead (mortality). They do not take into account the number of years the average dead person lived with the disease and the number of years of life the average dead person losses (as a result of death from the particular cause) compared to the normal healthy population. With such a measure, an infected person that dies at age 60 and the one that dies at age 35 all would count as the same, with no recognition for the number of years they might have lived with the disease which gives a good indication of the loss in productivity and the true cost of the disease. In a cross country comparison, a country that losses 10 35-year-olds may be weighed equally as one that losses 10 60-year-olds. Traebert et al. (2018) suggest that as ART rollouts have increased, HIV/AIDS is no more a death sentence but rather a chronic disease, hence a measure that incorporates mortality, morbidity and prevalence would be most appropriate. In place of such mortality measures, I recommend the Disability Adjusted Life Years (DALY) as a more potent measure, in that it accounts for years lost on average from the dead plus the average number of years lived with disability as a result of reduced capabilities from the disease. This provides a standard unit of measurement for cross country comparison as well as the comparison between different diseases if need be. In essence; DALY combines the two dependent variables looked at separately by Nunnenkamp and Öhler (2011) into one standard unit.

Another angle from which my study is an improvement on theirs is how I look at the heterogeneous effects DAH has on certain demographic groups (Women and Children) as well as different groups of countries (Democratic, Undemocratic, Stable, Unstable). What is more, my study covers more years between 1995 and 2017 and countries (115) than Nunnenkamp and Öhler (2011) and Hsiao and Emdin (2015). Nunnenkamp and Öhler (2011) argue that not much has been lost by excluding data from the mid 90's as DAH was not significant during that time. I argue that by excluding data from the mid 90's the picture painted by their work is not representative of the fight against the virus as far as DAH is concerned. Knowing how a few dollars' worth of DAH impacts the fight against HIV/AIDS is as important as how large amounts of DAH affects the burden of AIDS. Lastly and quite importantly, Nunnenkamp and Öhler (2011) assume the exogeneity of aid to HIV/AIDS mortality/ new infections and this could potentially bias their estimates. There could be time varying country specific unobservables such as differences in the health care system in recipient countries, changes in the burden of other diseases and such factors could have a relationship with DAH and new infections/mortality at the same time. Such unobservable time varying factors may not be captured by the Difference in Difference in Differences (DDD) approach used by Nunnenkamp and Öhler (2011). To guard against such possible causes of endogeneity I employ the Generalized Method of Moments (System GMM) estimation approach. GMM's instrumental-variable approach helps to address biases that may arise from such time-varying, country-specific unobservables that country and time-period fixed effects cannot cure.

In terms of methodology, as far as my efforts could reach, it is only Hsiao and Emdin (2015)[14] that employs the Generalized Method of Moments (GMM) to examine the effects of DAH on HIV/AIDS outcomes. Even though this methodology is quite frequently used in the general DAH

[14] Hsiao and Emdin (2015) use this methodology as a robustness check for their fixed effects model

effectiveness literature. With Afridi and Ventelou (2013), Gyimah-Brempong (2015), Mishra and Newhouse (2009) among others all using it to evaluate DAH effectiveness.

CHAPTER THREE

Model

In a novel attempt, I use Disability Adjusted Life Years (DALY) of HIV/AIDS in a particular year as the dependent variable to test the effects DAH has on the burden of HIV/AIDS. Like some previous studies within the space, I do so by estimating a health production function which has its roots from the Grossman (1972a) demand for health model, albeit on a macro or cross country level rather than the micro view of the original model. The Grossman model is preferred because of its view of health and human capital as an area for investment, in essence my adoption of the model looks at how various forms of investments (bilateral and multilateral DAH as well as public and private health spending) helps in reducing the burden of HIV/AIDS on a country's human capital. The model views health as a capital good that depreciates (at a constant rate) over time and may appreciate with the right investment. This assumption fits well with my main dependent variable (DALY of HIV/AIDS per country). The burden of HIV/AIDS can worsen or improve depending on the investment and policy measures applied to it. Finally, Grossman's (1972a b) model makes room for the dynamic nature of health. In a similar vein the burden of HIV/AIDS in a period relies in part on the burden from the previous period.

Earlier studies employed the health production function by controlling for some traditional health inputs like age, sex, education as well as some environmental factors, this framework has been further expanded to include measures of health aid in recent times. Efforts from Mishra and Newhouse (2009), Wilson (2011), Gyimah-Brempong (2015) among others are notable mentions in that regard. Unprecedentedly, and quite uniquely to my case i.e. estimating DAH effectiveness on HIV/AIDS, I include in my health production model the effects of other diseases in an effort to control for the presence of comorbidities. HIV/AIDS is quite notorious for the numerous other ailments that accompanies it because of the weakness it renders the immune system of its victims. According to Lorenc et al. (2014), people living with HIV/AIDS are likely to suffer from diabetes mellitus, cardiovascular diseases, respiratory infections, hepatic diseases (mostly Hepatitis B and C) among others. These diseases could severely affect or confound with the effects of DAH on HIV/AIDS if not controlled for. The foundations of my model therefore lies in Equation 1.

$$BOD_{xit} = f(BOD_{xit-1}, DAH_{xit}, BOD_{yit}, V_{it}) \quad (1)$$

From Equation 1, BOD_{xit} represents the burden of a particular disease (x) (which in this case happens to be HIV/AIDS) for a particular country *(i)* at a time *(t)*[15]. Just like in Grossman's (1972a) seminal model, entities inherit an initial health capital stock. This variable helps to control for the effects previous stocks of health have on an entities current state. BOD_{xit-1} , which represents the burden of disease (x) *of a* country *(i)* at a time *(t-1)* seeks to replicate this initial health capital stock in Grossman's (1972a) model. DAH_{itx} represents DAH per capita received to combat HIV/AIDS (x), for country *(i)* at a time *(t).* The DAH_{xit} variable is later disaggregated into bilateral and multilateral sources. BOD_{yit} represents the burden of all other diseases other than HIV/AIDS (y), for country *(i)* at a time *(t).* V_{it} is a vector of variables consisting of; public health spending per capita, personal income, percentage of total population between the ages of 15 and 49, level of insecurity within a country, female contraceptive prevalence and the percentage of urban dwellers[16]. I specify a linear functional form of the health production model as follows:

$$\ln DALY_{xit} = \beta_1 \ln DALY_{xit-1} + \beta_2 Bilateral\ Aid_{xit} + \beta_3 Multilateral\ Aid_{xit} + \beta_4 \ln DALY_{yit} + \beta_5 V_{it} + \beta_6 \alpha_i + \beta_7 \tau_t + \epsilon_{ijt} \quad (2)$$

From Equation 2 above, $\ln DALY_{xit}$, the main dependent variable represents the Log of the Disability Adjusted Life Years (DALY) for HIV/AIDS per 100,000 (i.e. 100 thousand) people, for country *(i)* at a time *(t).* $\ln DALY_{xit-1}$ represents the Log of DALY per 100,000 for country *(i)* for the previous year *(t-1).* The DAH variable from Equation 1 has been subdivided into $Bilateral\ Aid_{xit}$ and $Multilateral\ Aid_{xit}$ which represents DAH received for HIV/AIDS from governmental sources for country *(i)* at a time *(t)* and DAH received for HIV/AIDS received from non-governmental sources for country *(i)* at a time *(t).* $\ln DALY_{yit}$ represents the Log of DALY for all diseases excluding HIV/AIDS (y) per 100 000 people for country *(i)* at a time *(t).* The β_{is} are the various coefficients to be estimated. V_{it} is a vector of variables consisting of public and private health spending per capita to control for the effects government and personal out of

[15] The preferred variable to represent the burden of disease is Disability Adjusted Life Years (DALY) per 100 000 people, and this will be used to represent BOD_{it} in subsequent specifications.
[16] The WHO (2006) refers to the age group (15-49) as the reproductive age group. I employ this age group as a measure for sexual activity within a population as HIV/AIDS is classified as a sexually transmitted infection, Kenyon et al. (2014).

pocket health spending may have on the burden of HIV/AIDS. The vector also includes the contraceptive prevalence among women of reproductive age to control for the extent knowledge about reproductive health issues and lifestyle has on the burden of HIV/AIDS. Within the vector also lies the age structure of the population which is measured by the percentage of the population within the reproductive age bracket (the years 15 to 49 per WHO (2006)). This is in line with Grossman's (1972a b) model to know how age (and to a large extent sexual activity) affects the burden of HIV/AIDS. The vector also contains the Insecurity variable to control for the effects of political insecurity, conflicts and wars have on the spread of HIV/AIDS. I include the percentage of urban dwellers into the vector to control for the effects settlements can have on the spread of HIV/AIDS. Finally τ_t and α_i represent time and country fixed effects respectively. These are employed to control for the period and country specific effects that may determine the burden of HIV/AIDS.

DALY is a relatively new utility based health outcome measure developed in the early 1990's to aid in quantifying the burden of different diseases and injuries. One of the main motives for its development was to ease the comparison of different diseases and for cross country comparison of the burden of diseases (Chen et al. (2015)). It is the summation of the number of years lived with a disease and or the number the number of years lost as a result of not obtaining full life expectancy (in case of death) (Traebert et al. (2018)). Averaging across the population the DALY for say HIV/AIDS can be compared to that of Malaria to know the level of burden each disease has on a particular country. What is more, the DALY for HIV/AIDS for country A can be compared to that of country B as both are standardized estimates of years lived in sub optimal health. Better still, the aggregate DALYs for all diseases in country A can be compared to that of country B. Central to the calculation of DALY is the weighting of different diseases (as each disease has its own level of severity and disability it brings). One DALY can therefore be described as one year of full healthy life denied or lost. The most basic mathematical form for DALY of a particular disease (x) is as follows:

$$DALY_x = Years\ of\ Life\ Lost\ (YLL_x) + Years\ of\ Life\ Lived\ with\ Disability\ \ (YLD_x) \quad (3)$$

$$YLL_x = Number\ of\ Deaths_x * (\ Standard\ Life\ Expectancy\ at\ birth - Average\ Age\ at\ Death) \quad (4)$$

$$YLD_x = Number\ of\ Cases_x * Average\ Duration * Disability\ Weight_x \quad (5)$$

To obtain aggregate DALY for a particular disease, the aggregates of both YLL and YLD of the population for the disease is summed up. The two main components of DALY are the Years of Life Lost as a result of the disease in question and the Years of Life Lived with Disability from the same disease. The YLL of disease (x) is obtained by multiplying the number of years of average life expectancy that was denied by the number of deaths caused by the disease. On the other hand YLD of disease (x) is obtained by multiplying the disability weights assigned to the disease by its average duration and the number of cases of the disease. The World Health Organization (WHO) through its Global Burden of Disease (GBD) study fixes and reviews the disability weights for all diseases under study as well as the population average life expectancy. According to Traebert et al. (2018), the GBD (2015) places a 0.274 disability weight on HIV(pre AIDS) cases, 0.582 disability weight on HIV/AIDS without receiving ART and 0.078 disability weight on HIV/AIDS infected person receiving ART. According to the same GBD (2015) report, moderate Malaria carries 0.051 weight, whereas moderate diarrhea carries 0.188 disability weight. In the same report, WHO fixes the standard life expectancy at birth as 80.0 years for males and 82.5 years for females, WHO(2017). Chen et al. (2015) suggests that, the presence of comorbidities is one of the main detractors of DALY. The DALY function in Equation 3 does not give room for an individual to suffer from more than one disease at a time. This is however a real possibility and probably an acute problem for the case of HIV/AIDS. To counter the possible effects of comorbidities I control for the DALY of all other diseases combined excluding that of HIV/AIDS in my model.

In subsequent regressions, I employ the DALY for females and children below the age of 14 (per 100,000 people) to know the sexual/demographic distribution of the effects HIV/AID DAH has on the burden of AIDS. To test the robustness of my model and also to conform to most of the literature within the space, I employ YLL per 100 000 of the population (a measure of the mortality of HIV/AIDS, similar to the much used mortality measures). Because of the huge differences between heavily burdened countries and the least burdened, I linearize all the burden of disease variables I employ (i.e. DALY for the general population, DALY for female and children as well as YLL). By applying logs to the dependent variables, it produces a semi log specification where a US $1 change in per capita DAH leads to a specific percentage change in the burden of HIV/AIDS.

I follow the attempts from Gyimah-Brempong (2015), Mishra and Newhouse (2009) among others to include DAH as a health input. In the process I follow Afridi and Ventelou (2013), Masud and Yontcheva (2005) to distinguish between DAH channeled between two governments (i.e. Bilateral DAH) and those given through non-governmental organizations (Multilateral DAH). Nunnenkamp et al. (2009) suggests that it has been common knowledge that non-governmental organizations are closer to the people and as such are able to target the needy more than bilateral donors or even governments. They also posit that economic and political self-interest usually accompany bilateral aid. Notwithstanding Nunnenkamp and Öhler, (2011) suggesting HIV/AIDS DAH donations may not suffer from these biases, it is not uncommon for donors to give more aid to countries with similar interests or historical ties, Fuchs et al. (2014). Afridi and Ventelou (2013) also suggest that NGO may be able to circumvent corrupt and bureaucratic government procedures and may be more results oriented to help secure future funds from the contributors. These factors may render bilateral HIV/AIDS DAH less effective than that from multilateral sources. It is however expected that β_2 and β_3 (the main coefficients of note in this model) from Equation 2 will both have negative signs, with β_3 being greater than β_2 in absolute terms.

DAH as a whole may affect the burden of HIV/AIDS in a number of ways. According to the IHME (2018) report, HIV/AIDS DAH is given into these key areas; Treatment, Prevention, Health Systems Strengthening, Care and support, Orphans and vulnerable children, Counselling and testing and Prevention of Mother to Child Treatment (PMTCT). HIV DAH for prevention and treatment if effective can reduce the rates of new infections and also help reduce the viral loads of the already infected through ART rollouts. Another important mechanism through the prevention and treatment portal is the curtailing of mother to child transmissions. DAH could help increase accessibility of ART to pregnant mothers, improve child birth practices and appropriate infant feeding techniques, in effect reducing the number of direct transmissions to children from infected mothers. Health systems strengthening also ensures that the health care systems of recipient countries are made robust through improved health infrastructure and the adoption of evidence based policies among others. This may help recipient countries to independently combat outbreaks of HIV/AIDS as well as other diseases. Conversely, increased inflows of DAH may cause recipient governments to lose focus on other diseases and infections. Some of these diseases may infect, spread and burden the already weakened immune systems of people living with HIV/AIDS. Lu et al. (2010) and Dieleman et al. (2013) suggest that increased flow of DAH may induce recipient governments to divert funds to unintended expenditures. The possibility of HIV/AIDS being fungible will cause the burden of the disease to increase despite increases in donations.

In line with parallel literature I control for government health expenditure per capita and personal income. Lu et al. (2010), Van de Sijpe (2013) and Dieleman et al. (2013) all make points suggesting that a clear distinction be made between Government health expenditure as source (GHE-S) and Government health expenditure as agent (GHE-A). These refer to government health expenditure that is sourced domestically and actual total government health expenditure respectively. In an aid effectiveness setting (unlike a fungibility setting like that of Lu et al. (2010), Van de Sijpe (2013) and Dieleman et al. (2013)), this helps to ensure that the coefficients of bilateral aid per capita (on-budget aid) and that of government health expenditure per capita are unbiased. Following in their footsteps I achieve the GHE-S per capita variable by deducting bilateral aid per capita (on-budget aid per capita) from government health expenditure as agent per capita[17] .

Government health expenditure as source could affect the burden of disease in a number of ways. The expenditure may be used to train, recruit and pay health sector workers to help in the fight against the virus. This expenditure may also include spending on public health sensitization,

[17] As a precautionary measure, I estimate alternative equations where I use GHE-A rather than GHE-S.

provision of health infrastructure among others. Dreher et al (2008) make some compelling arguments as to why government spending may have a negative effect on some social outcomes (compared to ODA) and even though these arguments were mainly related to education, it may still have implications in the health sector. They argue that, a good chunk of government health expenditure goes into the remuneration of sector workers while ODA may go directly into impactful avenues like infrastructure and other implements that directly improves education or health outcomes in this case. They also argue that government expenditure may be biased against the poor or be based in a few urban centers because of resource constraints. In line with Dreher et al (2008) argument that per capita measures are more appropriate than per GDP measures in dealing with aid effectiveness relating to Millennium Development Goals, all aid, government and private health expenditure variables are measured in per capita terms[18]. The sign of the coefficient for public health spending as source is expected to be positive and the explanation could be attributed to the reasons given by Dreher et al (2008).

Gross National Income (GNI) per capita is used to represent private health care spending as a number of literature on the topic has shown a positive (albeit inelastic) relationship between incomes and private healthcare spending (Baltagi et al. (2016) ,Baltagi and Moscone (2010), Lago-Peñas et al. (2013)). Lago-Peñas et al. (2013) find a unitary elastic relationship between income and healthcare spending in the long run. I control for private health spending to know how much private health expenditure affects the burden of HIV/AIDS. Private health care expenditure features prominently in Grossman's (1972a b) model. The model suggests that health improves with more personal health care spending. Private expenditure on pharmaceutical products has been found to significantly improve life expectancy Caliskan (2009), Crémieux et al. (2005). One of the main critiques that Zweifel (2012) levels against Grossman's model is that it is only the sick that may spend on health care and that the relationship between health care spending and health is typically negative (Laporte (2015)). The sign of private health spending is however expected to be negative as wealthier countries are expected to spend more on HIV/AIDS treatment and prevention thereby reducing its burden.

[18] HIV/AIDS fell under the MDG 6, under the Sustainable Development Goals (SDG) it falls under goal number 3 (3.3.1 to be precise), where it is the goal to end the epidemic by 2030 Harries et al. (2018) and Alfvén (2017)

The model subsequently controls for a number of social inputs that feeds into health. I control for the level of sexual and reproductive health knowledge by employing the contraceptive prevalence rate among women of child bearing age. This variable can also be viewed as a measure of lifestyle which features quite often in health production functions. Smoking, eating and drinking habits, physical activity are some of the notable lifestyle choices that may affect health (Leof and Walach (2012)). Knowing and using certain forms of contraception especially condoms by both infected and the uninfected reduces the chances of spread, thereby reducing the burden of HIV/AIDS. The model also controls for the age structure of each country involved in the study. Age is an important determinant of health as can be seen from Grossman's (1972a b) model. Age also influences the extent of sexual activity. Lindau et al 2007 and Karraker et al. (2011) reports significant declines in sexual activity with age. I use the UN's reproductive age bracket (the years 15 to 49) and calculate the percentage of a country's population that falls within that age group as a proxy for the age structure of the country. Other things being equal having a high percentage of the total population within this age bracket should have a higher burden of HIV/AIDS.

The level of insecurity also has an impact on health. In analyzing the impacts violent conflicts have on the spread of HIV/AIDS, Iqbal and Zorn (2010) posit that one of the main mechanisms by which HIV/AIDS spreads under conflict situations is through the mass dislocation of the non-combatant population. They also observe the rampant sexual violence that comes in conflict situations as one of the main causes of the spread of the virus in unstable societies. I therefore include a measure of insecurity to control for these factors. Other things being equal, unstable countries are expected to have an increased burden of HIV/AIDS.

Data

This study employs a panel data between the years 1995 and 2017 (i.e. 23 years) covering a total of 115 countries that had received some form of HIV/AIDS DAH within the period. Compared to earlier studies, this paper covers the early stages of mobilizing and disbursing HIV/AIDS DAH up until recent times. Giving this paper a more complete picture as far as the chronicles of HIV/AIDS DAH mobilization and disbursement is concerned. In terms of geographic distribution it encompasses much larger sets of countries than previous literature within the space of DAH effectiveness and DAH for HIV/AIDS effectiveness for that matter. The data set cuts across all the six inhabited continents (with the North and South America being merged as one, as can be seen from Table 1 below). African countries make the bulk of the data as sub Saharan Africa remains the epicenter of the burden of HIV/AIDS. The following low burdened African countries were dropped because of data unavailability Djibouti, Sao Tome and Principe, Seychelles, Somalia and South Sudan. Ensuring maximum representation of Africa particular the sub Saharan region is particularly important because of how acute the burden of HIV/AIDS is on the sub region. Nunnenkamp and Öhler (2011) employ a cut-off point of at least 1 percent HIV prevalence, this significantly reduces their total sample to 47 countries. They cite World Bank (1999), which urged donors to focus on budding epidemics as they are the least costly to control. This studies ensures that both nascent and fully fledged outbreaks are all covered (right from the early stages until recent times) giving the fullest and clearest picture yet as far as HIV/AIDS DAH effectiveness is concerned.

Of particular note is the presence of some European countries included in the data. These eight countries are Albania, Belarus, Bosnia and Herzegovina, Montenegro, North Macedonia, Moldova, Serbia and Ukraine. According to the UNAIDS (2020 a), since 2010 new HIV infections within Eastern Europe has risen by 72 %. A detailed breakdown of the sample by sub region as well as a list of all countries are placed in Appendices A and B respectively.

Table 1: Regional Distribution of Countries within the sample

Region Name	Freq.	Percent
Africa	49	42.61
Americas	23	20.00

Asia	32	27.83
Europe	8	6.96
Oceania	3	2.61
Total	115	100.00

Source: Authors own compilation using Stata 16

The main dependent variable is HIV/AIDS DALY per 100,000 of the population in a particular country for a specific year. As far as my search could go, this is the first of its kind in the health aid effectiveness literature. This variable is obtained from the IHME 2019 database. The IHME computes the Global Burden of Disease report annually and within this report lies the DALY for over 300 diseases and injuries. The database runs from 1990 till present times. The database is subdivided into that for the general population, various age groups, sex and the constituents of DALY i.e. (YLL and YLD). All burden of disease variables are measured per 100,000 of the population. The burden of all other diseases apart from HIV/AIDS is used to control for the possibility of comorbidities. This variable is also sourced from the IHME data base. To obtain the variable, I deduct the burden of HIV/AIDS (i.e. DALY of HIV/AIDS per 100 000 of the general population) from the burden of all diseases (DALY of all diseases per 100 000 of the general population). Both variables are linearized to control for the significant differences between countries. The IHME database completely covers all the years included in this study for 204 countries and territories hence there are no gaps in the burden of disease variables.

Development Assistance for Health (DAH) variables, the main independent variables of note are also sourced from the IHME. According to IHME (2019 p2), DAH is a "financial and in-kind resources transferred from major health development agencies to low-income and middle-income countries with the primary intent of improving or maintaining health". The IHME database on DAH consists of estimated disbursements of DAH for different diseases like Malaria, Tuberculosis and HIV/AIDS (Wilson (2011)). This dataset is further classified by source and channel of final disbursement. Gyimah-Brempong (2015) suggests that, the IHME dataset is complete than others because of the institutes efforts to fill in missing values. This dataset is also favored by me because of its usage of actual disbursements figures rather than commitments as these two can differ significantly (Dreher et al. (2008)). According to Dieleman et al. (2013), the IHME sources its data from annual and project reports from the European Commission, World Bank, regional development banks as well as private and multilateral organizations like the Bill and Melinda Gates Foundation (BMGF), Global Alliance for Vaccines and Immunizations (GAVI), PEPFAR, Global Fund for AIDS, Tuberculosis and Malaria (GFATM) among others. To obtain bilateral and multilateral aid figures, I sort DAH variables by final disbursements and then sum up those disbursed by bilateral agencies and that of multilateral agencies for each country for all the years under the study[19]. I later divide the resultant figures by total population and GDP of their respective countries to obtain per capita and per GDP figures. Unless stated otherwise within the regressions all aid figures are measured in per capita terms and in 2019 constant US dollars.

The data on government health expenditure is also from the IHME 1995 database on Global Health Spending. From the dataset, total health spending for 195 countries and territories is divided into three domestic sources (i.e. Government health spending, out-of-pocket spending and prepaid private expenditures) and foreign sources in the shape of DAH. The domestic spending data is obtained from the World Health Organization's Global Health Expenditure database (Lu et al. (2010)). In line with Lu et al. (2010) and Dieleman et al. (2013), I obtain Government health expenditure as source variable by deducting bilateral HIV/AIDS DAH from Government health expenditure variable from the data set i.e. by assuming that the Government health expenditure variable within the dataset has elements of on budget aid in them. Because the IHME dataset on Global Health Spending only begins from 1995, the entire study's timeframe was truncated to begin from 1995. Again, to obtain per capita and per GDP measures I divide the resultant figures by their respective countries population and GDP estimates. All government health spending figures within the regressions are measured in per capita terms and also in 2019 constant US dollars unless stated otherwise.

[19] I use the code provided by IHME within the database itself to remove possible cases of double counted donations. In a lot of instances, Donor governments made donations to multilateral agencies rather than the recipient nations themselves, which is why I used the disbursing agency rather than the source of the funds.

The variables for personal income and percentage of urban dwellers are both taken from the World Bank 2020 database. The private health expenditure is represented by the Gross National Income for each country and year and is in US dollars measured using the World Bank Atlas method. The urban population is measured as the total population living in urban centers divided by the total population. The percentage of urban dwellers variable is subsequently logged to produce a log-log functional situation where a percentage change in urban dwellers leads to another percentage change in the burden of HIV/AIDS. The variables for the age structure and contraceptive prevalence are obtained from the UN's Department of Economics and Social Affairs. The World Prospects 2019 dataset contains population estimates for various age groups and sex from 1950 till 2020 for all countries and territories with at least 90000 inhabitants (World Population Prospects (2019)). I obtain the age structure variable by summing up the population between 15 and 49 years and dividing it over the total population for each year and country within the study. This variable is also logged. I obtain the figures for the contraception variable from the Family Planning Indicators database. This dataset contains estimates of a number of family planning indicators. Among these is the variable for contraceptive prevalence for all women of reproductive age, for married and unmarried women. I employ the contraceptive prevalence for all women of reproductive age as a proxy for knowledge/education on sexual and reproductive health issues for the entire population and as a proxy for lifestyle. The data contains estimates from 1970 up until 2030 projections for a total of 186 countries and territories.

Lastly, to control for the effects that conflicts and insecurity may have on the burden of HIV/AIDS, I create a variable for Insecurity from some of the component variables of the State Fragility Index developed by the Center for Systematic Peace 2018. The Fragility Matrix of the State Fragility Index scores each country on two criteria (Effectiveness and Legitimacy) in four different sectors, Security, Political, Economic and Social sectors. Implying that with each of the four sectors there is an Effectiveness and Legitimacy score, these eight different scores combine to give the State Fragility Index. Each score ranges from 0 to 3, with 0 being the least fragile (Stable) and 3 being the highest form of fragility. My Insecurity variable picks the Effectiveness and Legitimacy scores for countries in only the Security and Political sectors. In essence the Insecurity variable is a summation of the Political Effectiveness, Political Legitimacy, Security Effectiveness and Security

Legitimacy scores for all the countries under the study. The most a country could get in terms of fragility is 12 and the least is 0. From the SFImatrix (2018), Security Effectiveness is defined as a measure of general security and vulnerability to political violence. This variable is measured based on the concept of residual war. In measuring residual war, it is assumed that the effects of low level or short wars on the security of a country dissipates relatively quickly, on the other hand it may take up to 25 years for the instability of high casualty war to dissipate. Hence countries that have experienced some conflicts will score high in subsequent years even after the conflict has stopped. Security Legitimacy on the other hand is a measure of state repression from the government or ruling authority to its citizens. In the other half of my Insecurity variable lies Political Effectiveness and Political Legitimacy. The Political Effectiveness score is mainly made out of three variables these are regime durability, current leader's years in office and the number of coup events. Finally, the Political Legitimacy score comprises of the presence of Ethnic minorities being marginalized, polity fragmentation among others (SFImatrix (2018)).

Table 2 below gives a numerical summary of all variables used in the various regressions. Of particular note is the minimum value of the Government health expenditure as source variable which appears as negative. This happens to be the case when Government health spending as agent falls below that bilateral HIV/AIDS DAH received. In short, these governments spent less on their entire national health budgets than they received in bilateral HIV/AIDS DAH alone. This phenomenon was observed by Shiffman (2008) as part of the greater HIV/AIDS exceptionalism literature. An eye test of the data revealed that Mozambique (which had the largest deficit of US $8.64 per capita in 2011), followed by Haiti and Zambia (which had a deficit of US $4 per capita) were the highest offenders in that regard. As a robustness check later, I treat these countries as outliers and drop them entirely from the regressions.

Table 2: Descriptive Statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Log DALY (all groups)	2471	6.1985	2.4116	0.3383	10.9370

Log DALY (Female)	2471	5.9926	2.6301	0.2766	11.0766
Log DALY (Below 14yrs)	2471	5.3316	2.5253	0.1709	10.2945
Log YLL (all groups)	2471	6.1325	2.4336	0.1525	10.8999
Log YLL (Female)	2471	5.9222	2.6521	0.1315	11.0394
Total DALY(All groups)	2471	4109.1830	8660.7193	0.4026	56216.5829
Total DALY(Females)	2471	4678.2551	9961.8035	0.3187	64638.3447
Total DALY(Children)	2471	2194.5452	4657.2816	0.1864	29569.6267
Total YLL(All groups)	2471	3926.9829	8299.2913	0.1648	54170.7488
Total YLL(Females)	2471	4463.4766	9537.8229	0.1406	62281.5422
Log of Burden of All Diseases(Excluding AIDS)	2471	10.6125	0.4157	9.7895	12.1096
Bilateral HIV Aid per Capita	2471	1.4157	5.5680	0.0000	121.1509
Multilateral HIV Aid/Capita	2471	1.2370	3.5535	0.0000	52.9873
Bilateral HIV Aid/GDP	2471	0.0011	0.0030	0.0000	0.0241
Multilateral HIV Aid/GDP	2471	0.0011	0.0028	0.0000	0.0326
Total HIV DAH per capita	2471	2.6526	8.2677	0.0000	124.5747
GHE-S/per capita	2471	96.8214	138.6166	-8.6430	1113.3390
GH-A/per capita	2471	98.2370	138.6114	0.3901	1113.3390
GHE-S/GDP	2471	0.0312	0.0246	-0.0145	0.1701
GH-A/GDP	2471	0.0324	0.0241	0.0010	0.1701
Personal Income	2471	2604.2007	2785.5130	110.0000	15920.0000
Log of Age Structure	2471	1.5062	0.0481	1.3954	1.8106
Contraception Usage	2471	32.8486	15.2941	3.5000	69.7000
Log Insecurity	2471	1.5978	0.6055	0.0000	2.5649
Log Urban Population	2471	3.7743	0.4807	2.1297	4.5668
Polity2 Index	2427	2.5385	5.8736	-10.0000	10.0000
State Fragility Index	2471	11.6601	5.3543	0.0000	24.0000

Source: Authors own compilation using Stata 16

The results however remain unchanged. Another point of note is from the variable measuring the Total HIV DAH per capita received, this variable is created by summing up both bilateral HIV/AIDS DAH per capita and multilateral HIV/AIDS DAH per capita. An eye test reveals that a small group of highly burdened countries received exceptional high inflows of both bilateral and multilateral aid combined. For example in 2009 Botswana received a combined DAH spending of US $ 124.57 per capita while the average stood at US $ 2.65. By plotting the DALY (for all groups) against the Total HIV DAH per capita received, I drop nine outlying countries to test the robustness of my estimates[20]. The output of the graph plotting DALY (for all groups) against Total HIV DAH per capita received is placed in Appendix F. A detailed summary of all variables used in this study and their definitions can be found in the Appendix E.

Estimation Technique

In line with literature concerning aid effectiveness, I use two of the most commonly used approaches within this space. I estimate the dynamic health model in Equation 2 firstly, using the Fixed Effects approach and then subsequently the systems Generalized Method of Moments (GMM) estimator by Arellano and Bover (1995) and Blundell and Bond (1998). The Fixed Effects methodology was favored over the Random Effects after performing the Hausman specification test. One flaw in estimating dynamic models of the type in Equation 2 using the Fixed Effects methodology is the presence of dynamic bias (Nickell (1981)). In the case of this model, the lagged dependent variable $\ln DALY_{xit-1}$ will be endogenous to the demeaned error term (which is generated as a results of the fixed effects) because of its (i.e. the demeaned error term) relationship with ϵ_{ijt-1}. Hsiao and Emdin (2015) suggests that this is the case because, the Fixed Effects estimator thrives on demeaning at the entity or country specific level, the subsequent demeaned error term created in the process however depends on the error terms from each of the time periods. This renders the $\ln DALY_{xit-1}$ coming from the period before endogenous to the demeaned error term. In effect all coefficients estimated in the model would be inconsistent if they are correlated with $\ln DALY_{xit-1}$ (Mishra and Newhouse (2009)). Beck and Katz (2011) suggest that the so called Nickell bias becomes negligible in regressions with time periods greater than 20, however Mehrhoff (2009) suggest that in a Monte Carlo simulation by Judson and Owen (1999), they observe that even though the bias reduces with the time period, a significant bias may exist in samples with time periods as large as 30.

Another important factor to consider is the possible endogeneity of aid. In using the fixed effects estimator to estimate a dynamic panel model like that of Equation 2, there is cause to worry

[20] These countries are Botswana, Eswatini, Guyana, Lesotho, Malawi, Namibia, South Africa, Zambia and Zimbabwe. The graph showing DALY (for all groups) against their respective Total HIV DAH per capita received is shown in Appendix F.

about endogeneity as the residual ϵ_{ijt} may contain country specific and time varying factors that affects the burden of HIV/AIDS. Wilson (2011) suggests that, different recipient countries receive the amount of aid they get for a reason. Donors being rational entities may consider value for money (how effective every single dollar will be), cost effectiveness and where their support is needed most before giving out aid. As such if unobserved factors influencing the burden of HIV/AIDS are also taken into consideration by donors such that it determines the DAH they give, then endogeneity bias may exist. Despite these red flags, I still go ahead to estimate Equation 2 with the fixed effects estimator.

One approach used to overcome these potential pitfalls is the System and Difference GMM. These estimators have been used extensively in the health aid effectiveness arena alone. Gyimah-Brempong (2015), Hsiao and Emdin (2015), Afridi and Ventelou (2013), Wilson (2011), Mishra and Newhouse (2009) have all used these group of estimators. Mehrhoff (2009) suggests that the basic idea these estimators use to get around the Dynamic Panel Data bias is that, the lagged levels (i.e. for the Difference GMM) and the lagged differences (for the System GMM) are uncorrelated with the demeaned error term and hence can pass as valid instruments for the lagged endogenous variable. The instrumental variables approach of the GMM estimators also helps to cater for time varying and country specific unobservables which may escape the reach of the Fixed Effects model. The Difference GMM was the first to be developed by Holtz-Eakin et al. (1988) and then later by Arellano and Bond (1991), (Roodman (2009b)). The Difference GMM was ineffective in dealing with persistent time series which had a small number of observations. In estimators like these, the instrumental variables of the Difference GMM are weak and cannot be used as instruments for its first differenced variables (Bond et al (2001)). It is important to note that, because of the persistence of the burden of HIV/AIDS, the Difference GMM was rejected in favor of the System GMM. The System GMM improves upon the Difference GMM by including additional moment conditions in levels. This increases the amount of instruments that could be introduced thereby improving the estimator's efficiency (Arellano and Bover (1995)). One drawback with the System GMM however, is the proliferation of instruments. Roodman (2009b) suggests this problem is particularly acute for long panels as the instruments increase quadratically with each additional year or time. He goes on to say that, this leads to the over fitting of the instrumental regressors in the end leaving the endogeneity problem unsolved. The two common ways researchers use to get around the issue of instrument proliferation is by collapsing the instrument set and limiting the number of lags to be used as instruments. Combining these two methods leaves the instrument count unrelated to the number of years (Mehrhoff (2009)).

In line with Mehrhoff's (2009) assertion, I employ both techniques in all regressions except for the robustness checks where I test my model with an alternative method suggested by Mehrhoff (2009), the so called Principal Component Analysis (PCA)[21]. The combination of both techniques ensure my instrument set is substantially reduced and at every instance my instrument count is below the number of individual units. The Hansen and Sargan tests of over identification are crucial to any GMM estimation. They both show the validity of the instruments used as well as its subsets through the difference-in-Sargan/ Hansen tests. Roodman (2009a) suggests they do so by examining the lack of correlation between the instruments and the error term .The AR (1) and AR (2) statistics are often used to test for the presence of first and second order serial correlation in the idiosyncratic error term. In describing the use of these two tests, Andres and Vallelado (2008) puts across that, because of the use of first differenced transformations, some degree of first order serial correlation is acceptable, however the presence of second order serial correlation is unacceptable as it signals the presence of omitted variables.

Roodman (2009a) suggests that due to the many specifications that comes with the GMM estimators, it is advisable to list all specifications used in terms of the type of GMM estimator employed, the choice of standard error treatment used, number of lags among others. I follow Roodman's recommendations and make the following specifications. In my regressions I favor the two step System GMM because of the persistence of the time series[22]. In all specifications I use the two step robust standard error based on recommendations by Windmeijer (2005) except for the robustness checks where I use the one step System GMM. I also employ country and fixed

[21] In all specifications I estimate my model using the Roodman (2009a) user written Stata program of xtabond2, within this program lies the option pca which is used to apply the Principal Component Analysis.

[22] Blundell and Bond (2000) suggests that the System GMM produces more plausible results in situations where the dependent variable is persistent. The burden of HIV/AIDS in time T is determined in a large extent by the burden in the previous period T-1.

time effects in all specifications to account for correlations across countries and time periods. The time dummies are treated as strictly exogenous in all cases. All regressors are put into the instrument matrix in all cases. Unlike most of the literature on the DAH effectiveness, I treat all regressors as endogenous (this includes the lagged dependent variable). For the first differenced equations, their two period lagged values were used as instruments, lag limited and collapsed. This gives a syntax of *lag ((2, 2) eq (diff) collapse))* in Stata using the xtabond2 program. For the levels equation I use one period lagged values as instruments, lag limited to one and collapsed giving a syntax of *lag ((1,1) eq(level) collapse))*. The regressors are treated endogenous because of the possibility that shocks in the burden of HIV/AIDS can affect/determine these variables or better still some of these variables can be measured with error.

First of all the presence of endogeneity in DAH (Bilateral and Multilateral) is pretty much accepted by the literature within the space, Gyimah-Brempong (2015), Hsiao and Emdin (2015), Afridi and Ventelou (2013), Wilson (2011), Mishra and Newhouse (2009) all make references to this point. I argue that the same mechanism through which DAH becomes endogenous also apply for a number of the health inputs employed in my model. The bulk of my argument is based on the possibility of simultaneity bias. Shocks in the burden of HIV/AIDS can affect the age structure of a country. If certain unobserved factors causes the burden of HIV/AIDS to fall disproportionately on a particular age group, the dynamics of the demography changes. Clark (2006) suggests that, one of the major demographic impacts of the HIV/AIDS pandemic in Africa was the presence of numerous HIV/AIDS orphans. This implies significant loss of life among young adults of child bearing age, who constitute a particular age group. In the same vein unobserved factors that influence the burden of HIV/AIDS may cause changes in the contraceptive behavior of citizens. MacQuarrie (2014) finds that contraceptive behaviors change after having HIV tests. The burden of HIV/AIDS and the burden of all other diseases can be simultaneously determined. Because HIV/AIDS weakens the immune system, shocks in HIV/AIDS can also affect the burden of all other diseases on a particular country. On the other hand, the burden of HIV/AIDS can affect the settlement arrangements in a particular country. Shocks in the burden of HIV/AIDS may reduce the populations in certain areas more than others and may cause people to migrate to other areas. Shocks in HIV/AIDS can also affect the government health expenditure as well as private health spending or income. These shocks can induce government health spending through sensitizing campaigns, provision of testing and treatment services, hiring of new health sector workers among others. These shocks can reduce aggregate productivity of the populations leading to a fall in average personal incomes, other things being equal. Based on these factors I go ahead to estimate Equation 2 using both the Fixed Effects and System GMM approaches. The results and its discussions are treated in the next chapter.

CHAPTER FOUR

Results

In this section, I display and discuss the findings of the study so far. The first part takes a look at the effects of HIV/AIDS DAH has on the burden of HIV/AIDS for the total population (i.e. using Log of DALY (for all groups) as the dependent variable). Employing both the Fixed Effects and two step System GMM approaches. As has been discussed earlier, a significant negative relationship between DAH (bilateral and multilateral) and DALY implies a positive effectiveness of DAH.

Table 3: HIV/AIDS DAH and the Burden of HIV/AIDS, 1995-2017 Fixed Effects & Baseline GMM Estimates

	(1)	(2)	(3)
	Model 1	Model 2	Model 3
VARIABLES	Fixed Effects	GHE-A	GHE-S
Lagged Dependent Variable	0.94365***	0.98706***	0.98706***
	(0.01000)	(0.02353)	(0.02353)
Bilateral HIV Aid per Capita	-0.00170***	-0.00168*	-0.00149
	(0.00064)	(0.00097)	(0.00097)
Multilateral HIV Aid per Capita	-0.00385***	-0.01197**	-0.01197**
	(0.00089)	(0.00501)	(0.00500)
Gov. Health Expenditure per capita(as Source)			0.00018
			(0.00023)
Gov. Health Expenditure per capita(as Agent)	0.00020**	0.00018	
	(0.00009)	(0.00023)	
Personal Income	0.00000*	0.00000	0.00000
	(0.00000)	(0.00001)	(0.00001)
Log of Age Structure (% between 15-49)	0.19032	3.56468***	3.56498***
	(0.26975)	(1.31454)	(1.31493)
Contraception Usage (female(15-49 years))	-0.00131	0.00425	0.00425
	(0.00124)	(0.00330)	(0.00330)

Log Insecurity	0.00730	-0.02303	-0.02304
	(0.01076)	(0.04772)	(0.04772)
Log Urban Population	-0.02095	-0.38988	-0.38995
	(0.06618)	(0.24108)	(0.24112)
Log of Burden of All Diseases(Excluding AIDS)	0.11913***	0.18259	0.18254
	(0.03294)	(0.16849)	(0.16852)
F-Statistic	910.3	8664	8667
Number of Observations	2471	2471	2471
Number of Countries	115	115	115
Adjusted R-Squared	0.961		
Number of Instruments		42	42
AR(1)		0.0399	0.0399
AR(2)		0.140	0.140
Sargan p-val		0	0
Hansen p-val		0.225	0.225

Source: Author's own compilation using Stata 16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is Log of DALY (all groups). All Aid figures, Government Health Expenditure and Personal Income are measured in per capita terms. Country and Year fixed effects are included in all models however their coefficients have been omitted. Standard errors are reported in parentheses. Model 1 employs the Fixed Effects Model with standard errors clustered at the country level. Models 2 and 3 employ two-step system GMM estimator using Windmeijer's (2005) correction. The Sargan and Hansen p-val represents the p-values of Sargan and Hansen's J-test on instrument validity. AB AR (1) and AB AR (2) show p-values for Arellano and Bond's 1991 test of first- and second-order serial correlation in the differenced residuals. All explanatory variables are treated as endogenous. For the first differenced equations their two period lagged values were used as instruments for the levels equation I use one period lagged values as instruments

In column 1, Model 1 is used to show the effects DAH has on the burden of HIV/AIDS via the Fixed Effects approach. Columns 2 and 3 both use the two step system GMM approach, where all variables are treated as endogenous and lag limited to two instruments for the differenced equations and one for the levels equations respectively. Their instrument matrices are subsequently collapsed. The difference between Models 2 and 3 is the distinction between Government health expenditure as agent (Model 2) and Government health expenditure as source (Model 3) based on suggestions from Lu et al. (2010) and Dieleman et al. (2013).

Firstly, the F statistic for all three models strongly rejects (at α =0.01) the null hypothesis that all the slope coefficients are jointly equal to zero implying joint significance of all regressors in explaining the burden of HIV/AIDS. Another point of note is the highly significant coefficients of the lagged dependent variables in all three models at the significance level of α =0.01, implying that the current burden of HIV/AIDS is significantly dependent on the burden from the previous period. This justifies the inclusion of the lagged dependent variable. For the Fixed Effects model, both bilateral and multilateral DAH are significantly effective in reducing the burden of HIV/AIDS on the entire population (DALY (all groups)) at a significance level of α =0.01 in the short run, ceteris paribus. Based on the log linearized functional form of Equation 2, the Fixed Effects model predicts that, in the short run, a US $1 increase in per capita bilateral HIV/AIDS DAH results in a 0.17 % reduction in the DALY of HIV/AIDS (for all groups) per a 100,000 people. The same model predicts a reduction of 0.39% in the DALY of HIV/AIDS (for all groups) per a 100,000 people should there be a US $1 dollar increase in the multilateral HIV/AIDS DAH per capita in the short run, ceteris paribus. Comparatively, the shows that US $1 of multilateral HIV/AIDS DAH is about 2.3 times more effective than US $1 of bilateral HIV/AIDS DAH. This affirms my earlier suspicion. It is also in line with the observations of Masud and Yontcheva (2005), who find that aid channeled through nongovernmental means is more cost effective than aid bilaterally given. With a mean DALY of about 4109.2 years per 100, 000 people among the 115 countries within the sample, a US $1 increase in the multilateral per capita HIV/AIDS DAH would results in 15 years of healthy life accrued per 100,000 people. That of bilateral HIV/AIDS DAH per capita results in about 7 years of full healthy life saved per 100,000 people in the short run, ceteris paribus.

Two interesting results of note with Model 1 are the coefficients of both Government health expenditure per capita as agent and that of Personal income. According to the model, they are both positively significant on the burden of HIV/AIDS at a significance level of α =0.01 and α =0.1 respectively. Even though it may be counter intuitive, such results are not completely new in this literature. In a similar GMM specification Afridi and Ventelou (2013) find that, a 1% increase in lagged per capita government health expenditure increased adult mortality by 0.016% at a α =0.01 level, at the same level of significance they observe that a 1% increase in lagged private health expenditure increased adult mortality by 0.03%. I base my arguments on that made by

Zweifel (2012) and Dreher et al. (2008). Dreher et al. (2008) suggests that, government spending on social factors like health entails in a large part, some expenditures that may not directly reduce the burden of HIV/AIDS at least in the short run. Zweifel (2012) also argue that it is the sick that seeks or spends more on health, that is most people do not seek medical attention (thereby accruing medical expenditure) until they actually feel sick. For chronic diseases that have to be managed for a life time, personal health spending may not always imply a reduction in its burden, however bilateral or multilateral DAH can due to its scale and mass effect. The burden of all other diseases excluding HIV/AIDS is also found to be positively significant on the burden of HIV/AIDS at α =0.01 significance level, such that in the short run, a 1% increase in the burden of all other diseases results in a 0.11% increase in the burden of HIV/AIDS ceteris paribus. This goes to give suggestive evidence that the burden of HIV/AIDS may be linked to that of all other diseases. All the other variables including Insecurity, Contraceptive use, Age structure and Urban populations had their expected signs, however they were insignificant.

Models 2 and 3 employ the System GMM approach with Windmeijer (2005) adjusted standard errors. From the values of the Arellano and Bond's AR (2) statistic, there is no evidence to suggest the presence of second order serial correlation in the error terms. Quite importantly, the p values of the Hansen J statistic is at 0.225. Roodman (2009a) advised that ideally the p value of the Hansen J statistic should lie between (0.1 and 0.25). A p value of 0.225 means we do not have to reject the over identifying restrictions, signifying the validity of the instruments used. Because of the lag limits and the collapsed option used, the number of instruments remain within the acceptable range of being less than the number of groups.

Model 2 shows that at the significance level of α =0.1, a US $1 increase in per capita bilateral aid results in about a 0.17% decrease in the burden of HIV/AIDS in the short run. Also a 1.197% reduction in DALY (all groups) from a US $1 increase in per capita multilateral HIV/AIDS DAH in the short run ceteris paribus at a significance level of α =0.05. Compared to the mean burden of disease, a US $1 per capita bilateral HIV/AIDS DAH saves about 7 years of full healthy life per 100,000 people while the same amount multilateral HIV/AIDS DAH saves about 49 years of extra life years per 100,000 people in the short run. This again affirms the cost effectiveness of multilateral aid over bilateral aid. The mean per capita bilateral HIV/AIDS DAH of the 115 countries within the sample is US $ 1.42, while that of the multilateral HIV/AIDS DAH per capita is at US $ 1.24. At these rates, ceteris paribus multilateral HIV/AIDS DAH per capita is reducing DALY (all groups) by about 61 years per 100,000 people while bilateral aid per capita is doing about 10 years per 100,000 people among the 115 countries.

It is important to note that in the GMM models both public and private health expenditures are not significant any longer. However, the percentage of people living between the ages of 15 to 49 years become significant at α=0.01 significance levels, such that a 1% increase in the percentage of the population within this age group leads to a 3.5% rise in the burden of HIV/AIDS per 100,000 people ceteris paribus. This is not unexpected as the more people are within the reproductive age bracket, the more the expected sexual activity and the possibility of increased rates of transmissions ceteris paribus. Lu et al. (2010), Van de Sijpe (2013) and Dieleman et al (2013) have all indicated that Government health expenditure reported by governments could be measured in error as there is a chance bilateral aid (on budget aid) could be masked in there. If this is the case, then bilateral aid per capita and government health expenditure coefficients will be biased. Lu et al. (2010) therefore deducts total bilateral DAH from reported government health expenditure figures, in my scenario I deduct only bilateral HIV/AIDS DAH from the reported government health expenditure figures to cancel out any bilateral HIV/AIDS DAH that may be hiding in the reported government health expenditure figures. The product of this deduction is the government health expenditure as source variable. This variable is used in place of the reported government health expenditure variable in Model 3. According to the results from Model 3, these suspicions may have been confirmed. The coefficient of bilateral HIV/AIDS DAH per capita is no longer significant and has reduced in magnitude as well. As such, government health expenditure as source will be the preferred government health spending variable in subsequent regressions and Model 3 the main baseline model in this study. The coefficients for multilateral aid per capita however remains unchanged, such that in the short run ceteris paribus, a US $1 increase in multilateral HIV/AIDS DAH per capita results in a reduction of about 49 years on the DALY (all groups) per 100,000 people at a significance level of α=0.05. Also, a 1% increase in the percentage of the population falling between the ages of 15 to 49 results in a 3.5% increase in the burden of HIV/AIDS per 100,000 people.

Heterogeneous Effects of HIV/AIDS DAH

A number of studies have argued that the effects of aid could be seen more clearly when viewed in a disaggregated manner. In this section I look at how HIV/AIDS DAH may impact differently along two lines i.e. demographically and then institutionally. Demographically, I look at how HIV/AIDS DAH affects women and children compared to the general population. In terms of institutions I divide the sample into Democratic/ Undemocratic, Stable/Unstable groups based on the State Fragility Index and the Polity2 scores of each country. Using the Python programming language, I find the mean State Fragility and Polity2 scores (the mean score of each country gives a picture of how democratic or stable the country has been between 1995 and 2017) of all the 115 countries over the sample period and then group all countries that fall above the and below the 50th percentile. For the State Fragility Index countries whose means fall above the 50th percentile are classified as Unstable and the opposite as Stable. For Polity2 index countries that fall above the median value are classified as Democratic and below as Undemocratic. This gives me four sets of countries (Stable and Unstable) for the State Fragility Index and (Democratic and Undemocratic) for the Polity2 score[23]. As a result I can compare Democratic countries against Undemocratic ones as well as Stable against Unstable ones in the sample of countries within the sample period. This helps in identifying the existence of any different effects of HIV/AIDS DAH on different classes of countries.

Women and children constitute a good chunk of the vulnerable populations within developing countries (Langer (2015)). Quite unfortunately, in terms of HIV/AIDS women bear a disproportionate burden than men. In June 2016 (during the 70th session), members of the United Nations General Assembly adopted a new resolution against HIV/AIDS (Resolution A/RES/70/266). In that resolution, the head of states and country representatives made a number of declarations, the 46th declaration reads, We; "Remain deeply concerned that, globally, women and girls are still the most affected by the epidemic and that they bear a disproportionate

[23] Polity2 score ranks countries based their levels of democracy or autocracy from -10 to 10. With -10 representing a fully autocratic regime and 10 representing a fully democratic regime.

share of the caregiving burden. Note that the ability of women and girls to protect themselves from HIV continues to be compromised by physiological factors, gender inequalities, including unequal power relations in society between women and men and boys and girls" (UNGAPD(2016)). According to the Global Fund (2019), in sub Saharan Africa, women are twice as likely to get infected with HIV/AIDS as males and in some areas it is as much as five times. Infected women are also likely to transmit to their babies during pregnancy, child birth and breastfeeding in what is known as vertical transmissions. Each year over half a million newborns are infected through this mechanism alone. This has come against significant focus of HIV/AIDS DAH on women and children especially in terms of reducing mother to child transmissions.

I employ the variables Log DALY (Females) and Log DALY (below 14 years) as the two main dependent variables for both models (with all other specifications remaining the same as that of Model 3 in Table 3). I begin with looking at the heterogeneous effects HIV/AIDS DAH may have on women and children and then subsequently that of different classes of countries. Table 4 below explores the sexual and demographic heterogeneous effects of HIV/AIDS DAH.

Table 4: HIV DAH and the Burden of HIV/AIDS 1995-2017 GMM Effects on Women and Children

	(1)	(2)

VARIABLES	Model 4 Females	Model 5 Children(0-14 years)
Lagged Dependent Variable (1)	0.99749***	
	(0.02715)	
Lagged Dependent Variable (2)		0.97517***
		(0.04357)
Bilateral HIV Aid per Capita	-0.00270	-0.00073
	(0.00248)	(0.00174)
Multilateral HIV Aid per Capita	-0.01005	-0.01459
	(0.00625)	(0.00887)
Gov. Health Expenditure per capita(as Source)	0.00011	0.00008
	(0.00016)	(0.00027)
Personal Income	-0.00000	0.00002
	(0.00001)	(0.00001)
Log of Age Structure (% between 15-49)	2.07520**	2.79879*
	(0.82508)	(1.48293)
Contraception Usage (female(15-49 years))	0.00342	0.00524
	(0.00238)	(0.00511)
Log Insecurity	-0.03475	-0.07090
	(0.03335)	(0.06000)
Log Urban Population	-0.12958	-0.58001**
	(0.23626)	(0.26571)
Log of Burden of All Diseases(Excluding AIDS)	0.21056	0.15631
	(0.13686)	(0.19079)
F-Statistic	28602	1925
Number of Observations	2471	2471

Number of Instruments	42	42
Number of Countries	115	115
AR(1)	0.0336	0.000609
AR(2)	0.635	0.315
Sargan p-val	0.142	0
Hansen p-val	0.261	0.0794

Source: Author's own compilation using Stata 16

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is Log of DALY Female for Model 4 and Log of DALY Children for Model 5.All Aid figures Government Health Expenditure and Personal Income are measured in per capita terms. Country and Year fixed effects are included in all models, however their coefficients have been omitted. Standard errors are placed in parentheses. Models 4 and 5 employ two-step system GMM estimator using Windmeijer's (2005) correction. The Sargan and Hansen p-val represents the p-values of Sargan and Hansen's J-test on instrument validity. AB AR (1) and AB AR (2) show p-values for Arellano and Bond's 1991 test of first- and second-order serial correlation in the differenced residuals. All explanatory variables are treated as endogenous. For the first differenced equations their two period lagged values were used as instruments for the levels equation I use one period lagged values as instruments

For both models, the lagged dependent variable is strongly significant at α =0.01. Subsequently, the F statistic for both models strongly rejects the null hypothesis that all the slope coefficients are jointly equal to zero at the α =0.01 significance level. The Arellano and Bond AR (1) and AR (2) test statistics are all in acceptable ranges signifying that in both models there is no evidence of second order serial correlation in the error terms. The number of instruments remain the same as that of the models in Table 3 as the main structure has not changed. The p values of the Hansen J statistic for the Model 5 is however interesting. Even though it is insignificant as the literature suggests, it's too small to be reliable. Nonetheless, I find no evidence that HIV/AIDS DAH significantly improved the burden of HIV/AIDS on children at a rate higher than that of the general population.

The p values of the Hansen J test for females is pretty strong. According to the model both bilateral and multilateral aid are not significant towards reducing the burden of HIV/AIDS on women as compared to the general population. This has significant implications, ideally, the burden of HIV/AIDS on women should be decreasing and at a rate higher than that of children to ensure that a perpetual cycle of HIV/AIDS is not created, whereby mothers may keep on transmitting to their children and these children possibly passing it on in the near future. The model however finds that, having an increased population within the reproductive age bracket increases the burden of HIV/AIDS, such that, a 1% increase in the population within this age bracket increases the burden of HIV/AIDS on the female population by 2.1% per 100,000 people, ceteris paribus.

I subsequently take a look at the effects HIV/AIDS DAH has on different sets of countries by comparing Democratic and Undemocratic as well as Stable and Unstable countries.

Table 5: HIV DAH and the Burden of HIV/AIDS 1995-2017 GMM Heterogeneous Effects on Different Classes of Countries

VARIABLES	(1) Model 6 Democratic Countries	(2) Model 7 Undemocratic Countries	(3) Model 8 Stable Countries	(4) Model 9 Unstable Countries
Lagged Dependent Variable	1.00350***	0.91350***	1.02580***	0.94591***
	(0.01619)	(0.03584)	(0.02612)	(0.03469)
Bilateral HIV Aid per Capita	-0.00244**	-0.00504	-0.00388	-0.00358
	(0.00092)	(0.00733)	(0.00468)	(0.01566)
Multilateral HIV Aid per Capita	-0.01466**	0.00263	-0.01152	-0.02153**
	(0.00641)	(0.00694)	(0.00916)	(0.01035)
Gov. Health Expenditure per capita(as Source)	-0.00018	-0.00006	0.00019	0.00031
	(0.00031)	(0.00025)	(0.00025)	(0.00067)
Personal Income	0.00001	0.00002*	-0.00001	0.00002
	(0.00001)	(0.00001)	(0.00001)	(0.00003)
Log of Age Structure (% between 15-49)	2.20992	2.24995**	1.59564	0.69206
	(2.00090)	(1.07072)	(1.71890)	(1.63516)
Contraception Usage (female(15-49 years))	0.00701	0.00300	0.00290	0.00186
	(0.00500)	(0.00555)	(0.00370)	(0.00764)
Log Insecurity	-0.04374	-0.03750	-0.02468	-0.03676
	(0.03664)	(0.07081)	(0.06339)	(0.09272)
Log Urban Population	0.08653	-0.36582**	-0.03442	-0.47336**

	(0.14828)	(0.17102)	(0.12725)	(0.19778)
Log of Burden of All Diseases(Excluding AIDS)	0.55800**	0.35586**	0.40924	0.01050
	(0.25296)	(0.14456)	(0.31901)	(0.23393)
F-Statistic	22248	6252	18960	5245
Number of Observations	1214	1235	1254	1217
Number of Instruments	42	42	42	42
Number of Countries	56	58	58	57
AR(1)	0.0828	0.163	0.0422	0.266
AR(2)	0.189	0.445	0.147	0.0746
Sargan p-val	0.120	0	0.214	0
Hansen p-val	0.745	0.00921	0.262	0.212

Source: Author's own compilation using Stata 16

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is Log of DALY (all groups). All Aid figures Government Health Expenditure and Personal Income are measured in per capita terms. Country and Year fixed effects are included in all models, however their coefficients have been omitted. Standard errors are placed in parentheses. Model 6 represents a sample of countries above the median Polity2 value of the sample, Model 7 represents a sample of countries below the median Polity2 score of the average of each country over the sampling period. Model 8 represents a sample of counties below the median State Fragility Index and Model 9 represents the sample of countries above the median value after the average Fragility score of all countries over the sampling period was calculated. All models employ the two-step system GMM estimator using Windmeijer's (2005) correction. The Sargan and Hansen p-val represents the p-values of Sargan and Hansen's J-test on instrument validity. AB AR (1) and AB AR (2) show p-values for Arellano and Bond's 1991 test of first- and second-order serial correlation in the differenced residuals. All explanatory variables are treated as endogenous. For the first differenced equations their two period lagged values were used as instruments for the levels equation I use one period lagged values as instruments.

For all four classes of countries, from Models 6 to 9, the F statistic significantly rejects the null hypothesis that all coefficients are equal to zero at α =0.01. In all cases the number of groups exceed the number of instruments. For the sample on Democratic, Undemocratic and Unstable countries, the p value of Arellano and Bond's test signifies the presence of serial correlation in the error term. Hence it would be misleading to make any inferences on them. Model 8 however does not exhibit signs of serially correlated errors, the p value of the Hansen's J test statistic is also very good. The model does not show that HIV/AIDS DAH was more effective in the sample of Stable countries than the general sample. The evidence presented so far suggests that

HIV/AIDS DAH works irrespective of the socio political conditions in a recipient country, among those sampled.

Robustness Checks

In order to test the robustness of my results so far, I employ a number of sensitivity checks to test if the claims made so far can withstand different specifications, different estimation methods and the removal of some perceived outliers. I begin the robustness checks by exploring different estimation methods as well as exploring different specifications to the original model. In columns 1 of Table 6, I try using the one step System GMM instead of the two step System GMM used in the original model. This is despite suggestions that the one step System GMM may not be asymptotically efficient as the two step, Youssef et al. (2014). In the same table, I test my results by using the third and fourth lags as instruments for the differenced equations rather than the second period lags used in the baseline models. Finally, Mehrhoff (2009) suggests that using lag limits and the collapse option is too rigid or restrictive and that, the data itself should be let alone to decide how its transformation matrix should look like. This is achieved by applying the Principal Component Analysis (pca)[24]. In my specification I remove all lags, apply the pca option and then collapse the instrument set.

Table 6: HIV DAH and the Burden of HIV/AIDS 1995-2017 Robustness Checks Using Different Approaches

	(1)	(2)	(3)	(4)

[24] The Pca is an option that comes with the user written xtabond2 developed by Roodman (2009a), Bontempi and Mammi (2014).

VARIABLES	Model 10 One Step System GMM	Model 11 3 period Lags	Model 12 4 period Lags	Model 13 PCA
Lagged Dependent Variable	0.96788***	1.00859***	0.95844***	0.97442***
	(0.02097)	(0.03821)	(0.01778)	(0.01110)
Bilateral HIV Aid per Capita	-0.00328	-0.00343	-0.00126	-0.00028
	(0.00208)	(0.00284)	(0.00222)	(0.00123)
Multilateral HIV Aid per Capita	-0.01249*	-0.01427**	-0.01066**	-0.00688**
	(0.00677)	(0.00705)	(0.00537)	(0.00297)
Gov. Health Expenditure per capita(as Source)	-0.00010	0.00028	0.00018	-0.00008
	(0.00021)	(0.00025)	(0.00022)	(0.00017)
Personal Income	0.00001	-0.00000	0.00002	0.00002**
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Log of Age Structure (% between 15-49)	2.38842*	4.06880*	2.02369	2.21587*
	(1.43676)	(2.10205)	(1.34519)	(1.23223)
Contraception Usage (female(15-49 years))	0.00755**	0.00332	0.00398	0.00468**
	(0.00338)	(0.00367)	(0.00360)	(0.00234)
Log Insecurity	-0.00314	0.01065	0.00703	0.01238
	(0.05457)	(0.04509)	(0.04225)	(0.04184)
Log Urban Population	-0.38906*	-0.20938	-0.55552***	-0.28341***
	(0.20871)	(0.16220)	(0.15793)	(0.10624)
Log of Burden of All Diseases(Excluding AIDS)	0.18191	0.29115*	0.05156	0.14138
	(0.15664)	(0.17488)	(0.15178)	(0.11187)
F-Statistic	7199	4505	6083	16518
Number of Observations	2471	2471	2471	2471
Number of Instruments	42	42	42	103

Number of Countries	115	115	115	115
AR(1)	0.0462	0.0440	0.0412	0.0460
AR(2)	0.160	0.151	0.151	0.150
Sargan p-val	0	0	0	0
Hansen p-val	0.788	0.153	0.772	0.112

Source: Author's own compilation using Stata 16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is Log of DALY (all groups). All Aid figures Government Health Expenditure and Personal Income are measured in per capita terms. Country and Year fixed effects are included in all models, however their coefficients have been omitted. Standard errors are placed in parentheses. Model 10 employs the One step System GMM estimator with forward orthogonal deviations (FOD) .Robust standard errors are used. Models 11 and 12 employ two-step system GMM estimator using Windmeijer's (2005) correction. The Sargan and Hansen p-val represents the p-values of Sargan and Hansen's J-test on instrument validity. AB AR (1) and AB AR (2) show p-values for Arellano and Bonds 1991 test of first- and second-order serial correlation in the differenced residuals. All explanatory variables are treated as endogenous. For Model 10 in the first differenced equations their two period lagged values were used as instruments for the levels equation I use one period lagged values as instruments. In Models 11 and 12 three and four period lagged values are used for the first differenced equations respectively. In Model 13 all lags are removed and the pca option applied

Once again the inclusion of the lagged dependent variable has been justified, as all four models in Table 6 are significant at α =0.01. Their respective F statistics also proves to be significant as well. The number of instruments for the Models 10, 11, 12 remain the same as in previous regressions, as the structure remains the same except for replacing the two period lags used in the differenced equations in Models 11 and 12 with three and four period lags respectively. The number of instruments in Model 13 increased significantly to 103 after collapsing and applying the pca option. Nevertheless, instruments used in all Models remain below the number of groups which still stands at 115 countries. The general results from all four models do not differ much from the baseline models in Table 3. For all models in Table 6 above, multilateral HIV/AIDS DAH remains significant at α =0.05 except for Model 10 which employs the one step System GMM. Ceteris paribus, in the short run, a US $1 increase in per capita multilateral HIV/AIDS DAH results in a 1.25% (for Model 10), 1.43% (Model 11), 1.1% (Model 12) and 0.06% (Model 13) reduction in DALY (all groups) per 100,000 people respectively.

Interestingly, contraception was found to be significant and positively related with the burden of HIV/AIDS. Even though this sign was unexpected, some researchers have found that HIV/AIDS prevalent societies have high contraceptive usage rates. In a Demographic Health Survey (DHS) in five eastern and southern African states, MacQuarrie et al (2014) observed that HIV testing experience of pregnant women (notwithstanding the results) resulted in quicker adoption of contraception. They find that this adoption is even quicker in HIV/AIDS positive women as they quickly revise down their fertility preferences as they get to know their status. Keogh et al. (2012) also observe similar experiences from a study in Tanzania. This could be a likely explanation to the positive relationship between contraception and the burden of HIV/AIDS.

Models 10, 12 and 13 all observe a significant negative effect of the percentage of urban dwellers on the burden of HIV/AIDS per 100,000 people such that a 1% increase in the percentage of urban dwellers results in a 0.39%, 0.56% and 0.28% reductions for Models 10, 12 and 13 respectively. In a US based study comparing the adoption of HIV/AIDS treatment between rural and urban dwellers, Ohl et al (2013) observe that, a smaller percentage of rural dwellers are on treatment compared to their urban counterparts. When presented with the same opportunity, rural dwellers were less likely to take up ART. In most developing countries, HIV/AIDS testing, treatment and counselling centers may not be readily available in rural areas. This can possibly create the significant negative effects experienced between the variables for urbanization and the burden of HIV/AIDS.

The next set of robustness techniques I apply includes first, dropping the government health expenditure variable all together. This same technique was adopted by Dreher et al (2008). Government health spending figures is likely to be measured in error or better still other forms of bilateral DAH say that of Malaria could also be counted as domestically sourced, this may mean that even after deducting bilateral HIV/AIDS DAH from reported government health spending it may still be unreliable. I test my results against dropping this variable entirely. Another robustness checks I employ is by dropping countries that received exceptionally high sums of both bilateral HIV/AIDS DAH and multilateral HIV/AIDS DAH per capita (i.e. Total HIV/AIDS DAH per capita). I do so by comparing the amount they received against their actual burdens of HIV/AIDS. I plotted the average Total DALY per 100,000 people of all countries within the sampling period against their average Total HIV/AIDS DAH received within the same period. The resulting outlying countries were dropped. The results of the plot is placed in Appendix F of this study. The following countries emerged as outliers and subsequently dropped; Eswatini, Botswana, Namibia, Lesotho, Zimbabwe, Malawi, Zambia, South Africa and Guyana.

In column 3 of Table 7 below, I also drop a crop of three countries that had extremely low government health expenditure as source. These countries have total health budget per capita that were smaller than the bilateral HIV/AIDS DAH per capita they received in some years. The worst of these crop of countries were dropped. These are Haiti, Mozambique and Zambia. In the last column, I employ an entirely new dependent variable. For most of the literature on DAH effectiveness, the go to health outcome variable is usually centered on mortality measures like adult mortality rates, under five mortality rates, HIV/AIDS mortality rates etc. Hsiao and Emdin (2015), Gyimah-Brempong (2015), Afridi and Ventelou (2013), Nunnenkamp and Öhler (2011), Mishra and Newhouse (2009), all employ one or more measure of mortality. In this regard I drop the YLD component of the main dependent variable log of DALY (All Groups) per 100,000 people and use log of Years of Life Lost (All Groups) per 100,000 people as the new dependent variable. This is to test how my model reacts to a strictly mortality driven measure. The results of these robustness checks are placed in Table 7 below.

Table 7: HIV DAH and the Burden of HIV/AIDS 1995-2017 GMM Robustness Checks Dropping Some Variable and Countries

	(1)	(2)	(3)	(4)
	Model 14	Model 15	Model 16	Model 17
VARIABLES	GHE-S Dropped	DAH Outliers	GHE-S Outliers	YLL(All Groups)

Lagged Dependent Variable (1)	0.97955***	0.98816***	0.97969***	
	(0.02994)	(0.01864)	(0.02719)	
Lagged Dependent Variable (2)				0.98783***
				(0.02229)
Bilateral HIV Aid per Capita	-0.00151	-0.00461	-0.00159*	-0.00152
	(0.00104)	(0.01146)	(0.00092)	(0.00098)
Multilateral HIV Aid per Capita	-0.01137**	-0.03267**	-0.01135*	-0.01206**
	(0.00544)	(0.01434)	(0.00581)	(0.00489)
Gov. Health Expenditure per capita(as Source)		-0.00003	0.00015	0.00018
		(0.00021)	(0.00025)	(0.00022)
Personal Income	0.00001	-0.00000	0.00000	0.00000
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Log of Age Structure (% between 15-49)	3.04259***	1.70119	3.12433**	3.57020***
	(1.10683)	(1.16841)	(1.43607)	(1.32477)
Contraception Usage (female(15-49 years))	0.00481	0.00470	0.00469	0.00400
	(0.00332)	(0.00373)	(0.00349)	(0.00331)
Log Insecurity	-0.02306	-0.03272	-0.03786	-0.02127
	(0.04890)	(0.04688)	(0.05638)	(0.04833)
Log Urban Population	-0.41190	-0.17113	-0.40637	-0.37360
	(0.25222)	(0.19360)	(0.26008)	(0.24438)
Log of Burden of All Diseases(Excluding AIDS)	0.18151	0.18850	0.17160	0.18672
	(0.15784)	(0.17766)	(0.17642)	(0.16913)
F-Statistic	7633	5503	7588	8856
Number of Observations	2471	2273	2405	2471
Number of Instruments	40	42	42	42
Number of Countries	115	106	112	115
AR(1)	0.0410	0.0391	0.0406	0.0451
AR(2)	0.141	0.148	0.144	0.147
Sargan p-val	0	0	0	0

Hansen p-val	0.178	0.331	0.135	0.283

Source: Author's own compilation using Stata 16

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is Log of DALY (all groups) for all Models except for Model 17 where I use the Log of YLL (All Groups). All Aid figures Government Health Expenditure and Personal Income are measured in per capita terms. Country and Year fixed effects are included in all models, their coefficients have been omitted. Standard errors are placed in parentheses. Two-step system GMM estimator with the robust option i.e. Windmeijer's (2005) correction is applied. The Sargan and Hansen p-val represents the p-values of Sargan and Hansen's J-test on instrument validity. AB AR (1) and AB AR (2) show p-values for Arellano and Bonds 1991 test of first- and second-order serial correlation in the differenced residuals. All explanatory variables were treated as endogenous. For the first differenced equations their two period lagged values were used as instruments for the levels equation I use one period lagged values as instruments. In Model 14, the government health expenditure variable is dropped. In Model 15 countries that received exceptional amounts of DAH is dropped. In Model 16 countries that spent less on their health budgets are dropped. Model 17 employs a different dependent variable in the shape of Log of YLL per 100,000 people.

For all models, the lagged dependent variables, the number of instruments, the AR (1) and AR (2) as well as the p values of the Hansen J statistics are all in acceptable ranges. In all models, the multilateral HIV/AIDS DAH per capita is significant at α =0.05 significance level except for the Model 16 where its significance is at α =0.1. The basic results of my Model in Table 2 has so far remained similar to the results from Table 7 despite the number of tweaks applied to it. Quite importantly, it is observed from Model 17 that multilateral HIV/AIDS DAH was significant in reducing the amount of years lost to death. Such that, a US $1 increase in multilateral DAH per capita, resulted in a 1.2% reduction in the years of life lost per 100,000 people. At a sample average of 3926.98 YLL per 100,000, a US $1 increase in multilateral HIV/AIDS DAH will result in a reduction in the years lost to HIV/AIDS by 47 years per 100,000 people in the short run, ceteris paribus.

Finally, I try changing the measurement of multilateral HIV/AIDS DAH, bilateral HIV/AIDS DAH and government health spending as source. This time I measure them in per GDP terms rather than in per capita terms. The results are found in Table 8 below.

Table 8: HIV DAH and the Burden of HIV/AIDS 1995-2017 GMM Estimates Using Per GDP Measures.

	(1)

VARIABLES	Model 18 Per GDP Estimates
Lagged Dependent Variable	0.98071***
	(0.02523)
Bilateral HIV Aid/GDP	-4.30115
	(5.18861)
Multilateral HIV Aid/GDP	-15.71069**
	(6.32025)
Gov. Health Expenditure/GDP(as Source)	-0.12438
	(0.85380)
Personal Income	0.00001
	(0.00001)
Log of Age Structure (% between 15-49)	1.07971
	(1.31134)
Contraception Usage (female(15-49 years))	0.00380
	(0.00244)
Log Insecurity	-0.00507
	(0.04142)
Log Urban Population	-0.36858*
	(0.21559)
Log of Burden of All Diseases(Excluding AIDS)	0.02470
	(0.13633)
F-Statistic	6997
Number of Observations	2471
Number of Instruments	42
Number of Countries	115
AR(1)	0.0394
AR(2)	0.145
Sargan p-val	0
Hansen p-val	0.433

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is Log of DALY All Groups. All Aid and Government Health Expenditure are measured in per GDP terms. Country and Year fixed effects are included in all models, their coefficients have been omitted. Standard errors are placed in parentheses. Two-step system GMM estimator with the robust option i.e. Windmeijer's (2005) correction is applied. The Sargan and Hansen p-val represents the p-values of Sargan and Hansen's J-test on instrument validity. AB AR (1) and AB AR (2) show p-values for Arellano and Bond's (1991) test of first- and second-order serial correlation in the differenced residuals. All explanatory variables were treated as endogenous. For the first differenced equations their two period lagged values were used as instruments for the levels equation I use one period lagged values as instruments

Like the baseline model in Table 3, Lagged dependent variable, the AR (1), AR (2), Hansen, number of instruments are all in good and acceptable ranges. According to Model 18 other things being equal a 0.01% increase in the multilateral DAH per GDP results in a 15% reduction in the burden of HIV/AIDS measured by Log of DALY (All Groups) per 100,000 people. The mean multilateral HIV/AIDS DAH per GDP stands at 0.0011 per GDP. This implies that on average multilateral HIV/AIDS DAH is doing about 1.65% reduction in the burden of HIV/AIDS other things being equal at a significance level of α =0.05. This figure translates to about a reduction of 68 DALY's per 100,000 people.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

This study looked at the impacts HIV/AIDS has on the burden of disease measured as the DALY (All Groups) per 100,000 people between the years 1995-2017 for a sample of 115 countries. The study was conducted based on the hypothesis that both bilateral and multilateral HIV/AIDS DAH has been significantly effective in reducing the burden of HIV/AIDS and that this effect was also positive for vulnerable groups like women and children. It was also assumed prior to the study that there was a heterogeneous effect of HIV/AIDS DAH on different classes of countries, such that Stable and Democratic countries would experience a much greater effect than Unstable and Undemocratic countries.

Using a dynamic health model inspired by the demand for health model developed by Grossman (1972a b), I tested the effects health inputs like health endowment, bilateral HIV/AIDS DAH, multilateral HIV/AIDS DAH, age, contraception (lifestyle), settlement (urbanization) and security had on total Disability Adjusted Life Years (DALY) of HIV/AIDS for a particular country per 100,000 people. The System GMM approach developed by Arellano and Bover (1995) and Blundell and Bond (1998) is used to get over the issues of endogeneity and dynamic panel bias present when using the Fixed Effects approach. To overcome my preferred estimation strategy's own shortcomings of instrument proliferation, two period lags (which were lag limited and collapsed) are used as instruments for the first difference equations while treating all variables as endogenous.

The results show that firstly, multilateral DAH per capita is significantly associated with reductions in the burden of HIV/AIDS such that, a US $1 increase in multilateral HIV/AIDS DAH per capita resulted in about 49 years of improved healthy life years enjoyed per 100,000 people. Contrary to earlier hypothesis, bilateral HIV/AIDS DAH was found not to be significant in reducing the burden of HIV/AIDS. It was also observed that government health spending was not significant in reducing the burden of HIV/AIDS. Contrary to my hypothesis prior to this study, vulnerable groups did not benefit significantly from HIV/AIDS DAH compared to the general population. What is more? , HIV/AIDS DAH performed irrespective of democratic or stable political environment. Most of the literature that looks at DAH effectiveness do not distinguish between bilateral and multilateral DAH, Gyimah-Brempong (2015), Hsiao and Emdin (2015), Mukherjee and Kizhakethalackal (2013), Wilson (2011) and Mishra and Newhouse (2009) are all notable mentions in that regard. Among those that do distinguish between the two, Masud and Yontcheva (2005) finds multilateral aid to be more effective than bilateral aid. Conversely, Afridi and Ventelou (2013) observes using the GMM specification that at a significance level of α =0.01, bilateral DAH reduced adult mortality by 0.003% while multilateral DAH caused a reduction of 0.0013% signifying that bilateral DAH may be more effective than multilateral DAH. Nunnenkamp and Öhler (2011), in comparing bilateral and multilateral HIV/AIDS DAH using the Difference in Differences method found that multilateral HIV/AIDS DAH was not significantly effective compared to bilateral HIV/AIDS DAH.

This is in contradiction to my results. I believe the key may lie in how government health expenditure is treated. Both Nunnenkamp and Öhler (2011) and Afridi and Ventelou (2013) control for government spending but do not account for the fact that elements of bilateral (on budget aid) may be masked in there. In my estimates, bilateral HIV/AIDS was significant until this correction was made.

In terms of the heterogeneous effects of DAH or specifically HIV/AIDS DAH, this study is ground breaking. The declaration by the UNGAPD (2016, resolution: A /RES/70/266) as well as that of other AIDS related agencies had shown that in terms of the burden of the disease, women bore an equally high proportion. This study has given suggestive evidence for the first time that, indeed even though the burden of HIV/AIDS is being significantly reduced among the general population the same cannot be said about the female population as far as multilateral DAH effectiveness is concerned. The evidence given so far suggests that claims that HIV/AIDS infection rates among women and young girls is multiple times higher than the general population is more likely to be true than it is false. And that the ineffectiveness of multilateral HIV/AIDS DAH to significantly reduce the burden among females could be a consequence of these high rates. The evidence presented on the effects of HIV/AIDS DAH on children is also ground breaking. While multilateral HIV/AIDS DAH was found to be effective in reducing the burden of AIDS on the general population, it did not have any effect on the burden of AIDS on children. This may imply that despite significant efforts to reduce vertical transmissions from mother directly to children, these efforts have not been effective.

Based on the evidence presented so far, the following policy recommendations would be made. Bilateral donor partners should increase their funds allocated to multilateral agencies to improve on efficiency and value for money on every dollar of HIV/AIDS DAH given. In terms of DAH by source, a huge chunk of HIV/AIDS DAH comes from bilateral donors, Mishra and Newhouse (2009) suggests that bilateral aid constitutes between 70 to 90% of general health aid. This figure may be smaller in terms of HIV/AIDS DAH due to the significant contributions made by private entities like the Bill and Melinda Gates Foundation (BMGF). Per the summary data from Table 2, average bilateral aid per capita stands at US $ 1.42 while average multilateral HIV/AIDS DAH per capita stands at US $ 1.24, this suggests that in terms of channel of disbursement much of bilateral aid at source is disbursed by multilateral channels. I suggest that to improve on efficiency and value for money, based on the evidence so far, bilateral donors should relinquish much of their funds to multilateral agencies for disbursement. Afridi and Ventelou (2013) also make a similar recommendation.

In April 2021, the UK government grabbed international headlines when it announced an 83% reduction in its yearly donations to the UNAIDS. Instances like these are worrying considering the evidence presented from this study. Conversely, bilateral partners should be funding more, the activities of multilateral donor agencies as a dollar from them achieves more than two dollars from bilateral donors based on the findings of this paper, ceteris paribus

Another recommendation is that attention should be given towards ensuring that HIV/AIDS DAH is impactful on women and children. Based on the evidence given so far, the burden of HIV/AIDS on these groups of people has not reduced compared to the general population. According to UNAIDS (2020 a), 4500 young women between the ages of 15 to 24 get infected with HIV every week. This rate is alarming. Not only are this number of infections being recorded in a week but also the chances of pregnancy leading to a possible vertical HIV/AIDS transmission. The UNGAPD (2016) suggests that this may be due to do mostly with the significant unfavorable social, health and economic conditions that women and young girls endure in most developing countries. I therefore recommend that, much attention be given to the reproductive health issues women especially young girls face to ensure the burden of HIV/AIDS is addressed among vulnerable groups.

The issue about HIV DAH possibly not having any effect on the burden of HIV/AIDS on women and children is very important. Going forward, I recommend future research to look into testing this phenomenon with different methodologies and datasets to help establish its veracity and look into ways that could curb this worrying trend. The IHME database disaggregates HIV/AIDS data by purpose of donations. Some of the areas of donations include counselling and testing, prevention and treatment, prevention of mother to child transmissions, health systems strengthening etc. Using the disaggregated data by purpose of donations future research can establish which of the different purposes has been most potent, in reducing the burden of HIV/AIDS on the general population as well as on vulnerable groups.

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APPENDICES

Appendix A : Cross Tabulation of Regions and their Sub Regions

Cross Tabulation of Regions and their Sub Regions

Region Name	Sub-region Name											
	Central Asia	Eastern Asia	Eastern Europe	Latin America and the Caribbean	Melanesia	Northern Africa	South-eastern Asia	Southern Asia	Southern Europe	Sub-Saharan Africa	Western Asia	Total
Africa	0	0	0	0	0	6	0	0	0	43	0	49
Americas	0	0	0	23	0	0	0	0	0	0	0	23
Asia	5	2	0	0	0	0	9	8	0	0	8	32
Europe	0	0	3	0	0	0	0	0	5	0	0	8
Oceania	0	0	0	0	3	0	0	0	0	0	0	3
Total	5	2	3	23	3	6	9	9	5	43	8	115

List of Sub Regions in Order of Appearance in Appendix A

Central Asia

Eastern Asia

Eastern Europe

Latin America and the Caribbean

Melanesia

Northern Africa

South Eastern Asia

Southern Asia

Southern Europe

Sub Saharan Africa

Western Asia

Appendix B : List of Recipient Countries

List of Recipient Countries

Afghanistan	Dem Rep of the Congo	Lebanon	Senegal
Albania	Dominican Republic	Lesotho	Serbia
Algeria	Ecuador	Liberia	Sierra Leone
Angola	Egypt	Libya	Solomon Islands
Argentina	El Salvador	Madagascar	Tajikistan
Armenia	Equatorial Guinea	Malawi	Sri Lanka
Azerbaijan	Eritrea	Malaysia	Sudan
Bangladesh	Eswatini	Mali	Suriname
Belarus	Ethiopia	Mauritania	South Africa
Benin	Fiji	Mauritius	Thailand
Bhutan	Gabon	Mexico	Timor-Leste
Bolivia	Gambia	Mongolia	Togo
Bosnia and Herzegovina	Georgia	Montenegro	Tunisia
Botswana	Ghana	Morocco	Turkey
Brazil	Guatemala	Mozambique	Turkmenistan
Burkina Faso	Guinea	Myanmar	Uganda
Burundi	Guinea-Bissau	Namibia	Ukraine
Cabo Verde	Guyana	Nepal	Tanzania
Cambodia	Haiti	Nicaragua	Uruguay

Cameroon	Honduras	Niger	Uzbekistan
Central African Republic	India	Nigeria	Venezuela
Chad	Indonesia	North Macedonia	Vietnam
Chile	Iran	Pakistan	Yemen
China	Iraq	Panama	Zambia
Colombia	Jamaica	Papua New Guinea	Zimbabwe
Comoros	Jordan	Paraguay	
Congo	Kazakhstan	Peru	
Costa Rica	Kenya	Philippines	
Cuba	Kyrgyzstan	Republic of Moldova	
Côte d'Ivoire	Laos	Rwanda	

Appendix C : List of Multilateral Donors

LIST OF MULTILATERAL DONORS

African Development Bank (AfDB)	International NGOs (INTLNGO)
Asian Development Bank (AsDB)	Joint United Nations Programme on HIV/AIDS (UNAIDS)
Bill & Melinda Gates Foundation (BMGF)	Pan American Health Organization (PAHO)
Coalition for Epidemic Preparedness Innovations (CEPI)	United Nations Population Fund (UNFPA)
European Commission (EC)	United Nations Children's Fund (UNICEF)
Gavi, the Vaccine Alliance (GAVI)	US NGOs (NGO)

Global Fund to Fight AIDS, Tuberculosis, and Malaria (GFATM)	World Health Organization (WHO)
Inter-American Development Bank (IDB)	US Foundations (US_FOUND)
International Development Association (IDA)	UNITAID
International Bank for Reconstruction and Development (World Bank)	European Economic Area (EEA)

Source: **Institute for Health Metrics and Evaluation IHME DAH Database (2019) User Guide**

I use the codes of these organizations (described in the user guide as multilateral) to sort all DAH disbursed by Multilateral Agencies

Appendix D : List of Bilateral Donors

LIST OF BILATERAL DONORS

Australia	Greece	Norway
Austria	Ireland	Portugal
Belgium	Italy	Spain
Canada	Japan	Sweden
Denmark	Korea	Switzerland
Finland	Luxembourg	United Arab Emirates
France	Netherlands	United Kingdom
Germany	New Zealand	United States
China		

Source: **Institute for Health Metrics and Evaluation IHME DAH Database (2019) User Guide**

Appendix E: List and Definitions and Sources of variables

List and Definitions and Sources of variables

Variable	Description of Variable	Source of Variable Data
Bilateral HIV Aid per Capita	Total Development Assistance between two governments to combat HIV/AIDS per head annually. Measured in 2019 constant US dollars	Institute for Health Metrics and Evaluation (IHME) (2017)
Bilateral HIV Aid/GDP	Total Development Assistance from donors to a specific country against HIV/AIDS as a share of GDP annually. Measured in 2019 constant US dollars	Institute for Health Metrics and Evaluation (IHME) (2017)
Contraception rate (Female)	Percentage of women aged 15 to 49 years who use any form of contraception	**Department of Economics and Social Affairs, UN 2020**
Government Health Expenditure GH-A /capita as Agent	Government Health Spending divided by Total Population measured in 2019 constant dollars. This figure includes on budget aid	Institute for Health Metrics and Evaluation (IHME),2017
Government Health Expenditure GH-S /capita as Source	Government Health Spending entirely from domestic sources divided by Total Population measured in 2019 constant dollars	Institute for Health Metrics and Evaluation (IHME),2017
Government Health Expenditure GH-A /GDP as Agent	Government Health Spending as a share of GDP measured in 2019 constant dollars. This figure includes on budget aid	Institute for Health Metrics and Evaluation (IHME),2017
Government Health Expenditure GH-S /GDP as Source	Government Health Spending entirely from domestic sources as a share of by GDP measured in 2019 constant dollars	Institute for Health Metrics and Evaluation (IHME),2017
Log DALY (all groups)	It is the log of the summation of the years of life lived in ill health plus the years of life lost as a result of a particular disease across all age groups per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)

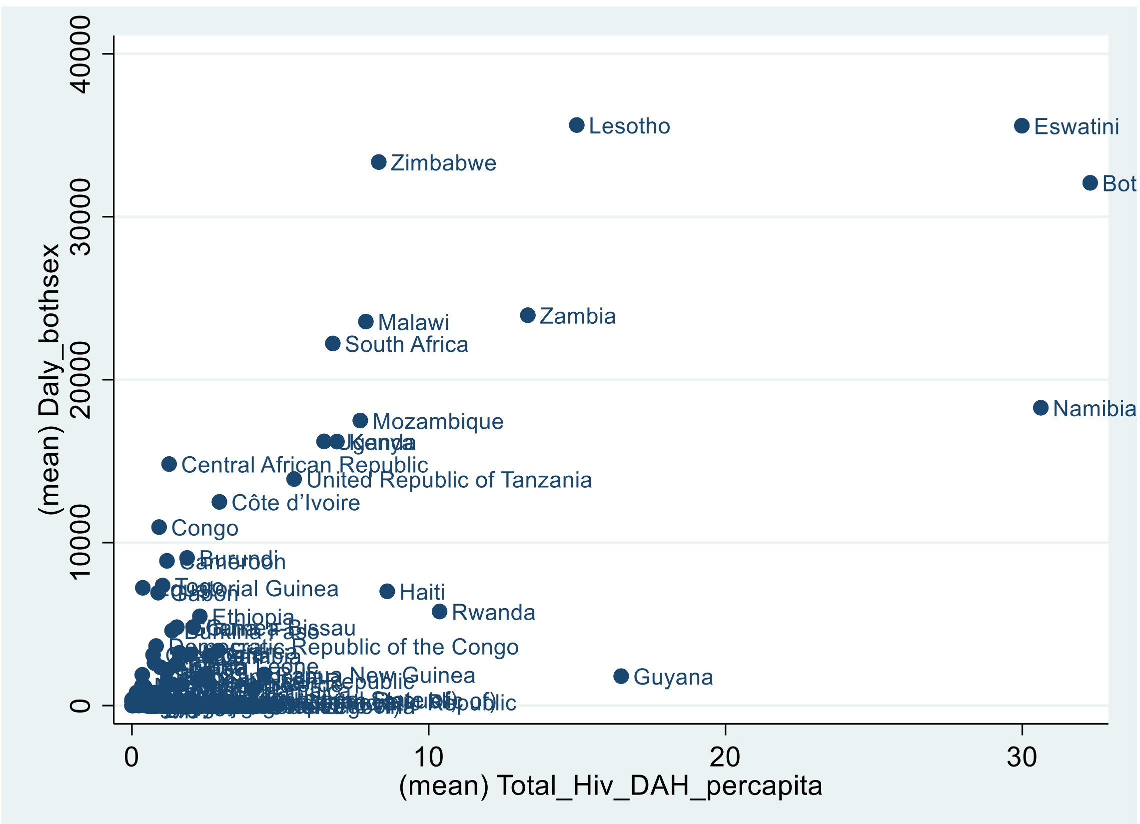
Log DALY (Female)	It is the log of the summation of the years of life lived in ill health plus the years of life lost as a result of a particular disease for the female population per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)
Log DALY (Below 14yrs)	It is the log of the summation of the years of life lived in ill health plus the years of life lost as a result of a particular disease for children below 14 years per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)
Log YLL (all groups)	It is the log of the summation of the number of years short-lived in comparison to the average life expectancy across all age groups per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)
Log YLL (Female)	It is the log of the summation of the number of years short-lived in comparison to the average life expectancy for the female population per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)
Log of Burden of All Diseases(Excluding AIDS)	It is the log of the summation of all the DALY for other diseases excluding HIV/AIDS	Institute for Health Metrics and Evaluation (IHME) (2019)
Log Insecurity	Log of the summation of the ratings for 4 variables in the State Fragility Index for each country. The variables are Security Efficiency, Security Legitimacy, Political Efficiency and Political Legitimacy.	**Center for Systemic Peace, 2018**
Log Urban population	Log of the percentage of total population living in Urban areas	World Bank, 2020
Log Age Structure	Log of the proportion of the population between 14 and 49	United Nations, Department of Economics and Social Affairs,2019
Multilateral HIV Aid per capita	Total Development Assistance from donors (Private corporations and NGO's) to a specific country against HIV/AIDS per head annually. Measured in 2019 constant US dollars	Institute for Health Metrics and Evaluation (IHME) (2017)
Multilateral HIV Aid/GDP	Total Development Assistance from donors (Private corporations and NGO's) to a specific country against HIV/AIDS as a percentage of GDP. Measured in 2019 constant US dollars	Institute for Health Metrics and Evaluation (IHME) (2017)

Personal Income	Represented by the Gross National Income per capita. This variable is used to proxy for private health expenditure	World Bank, 2020
State Fragility Index (Sfi)	A combination of social, economic, and political component indicators that shows how fragile a state is. For countries that have been partitioned or seceded from other countries like Yugoslavia, Serbia, Montenegro, Indonesia and Timor-Leste, Sudan and South Sudan, I use values for their parent countries for years these new countries did not exist. The SFI score ranks from 0 to 24, with 24 being the most fragile.	**Center for Systemic Peace, 2018**
Polity2 Score	The Polity2 score grades countries on a scale of -10 to 10. With 10 being a fully Democratic country and -10 being fully Autocratic. For countries that have been partitioned or seceded from other countries like Yugoslavia, Serbia, Montenegro, Indonesia and Timor-Leste, Sudan and South Sudan, I use values for their parent countries for years these new countries did not exist. The SFI score ranks from 0 to 24, with 24 being the most fragile.	Center for Systematic Peace,2018
Total DALY(All groups)	It is the summation of the years of life lived in ill health plus the years of life lost as a result of a particular disease across all age groups per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)
Total DALY(Females)	It is the summation of the years of life lived in ill health plus the years of life lost as a result of a particular disease for the female population per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)
Total DALY(Children)	It is the summation of the years of life lived in ill health plus the years of life lost as a result of a particular disease for children below 14 years per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)
Total YLL(All groups)	It is the summation of the number of years short-lived in comparison to the average life expectancy across all age groups per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)
Total YLL(Females)	It is the summation of the number of years short-lived in comparison to the average life expectancy for the female population per 100,000 people	Institute for Health Metrics and Evaluation (IHME) (2019)

Total HIV DAH per capita	Summation of Multilateral and Bilateral HIV DAH per capita. Measured in 2019 constant US dollars	Author's own summation

Appendix F: Graph Showing Burden of Disease against Total HIV/AIDS per capita received

Graph Showing Burden of Disease against Total HIV/AIDS per capita received



Source: Author's own compilation using stata 16

This diagram was generated by plotting average DALY of all groups against average Total HIV DAH per capita. I first find the average DALY of each country between 1995 and 2017 and then the average sum of both bilateral and multilateral DAH for each country. As a result of the diagram; the following countries were treated as outliers and dropped.

Guyana, Namibia, Botswana, Eswatini, Lesotho, Zimbabwe, Malawi, Zambia and South Africa.

Appendix G: Hausman Test Results

Sargan Hansen Statistic	P- Value
216.894	0.00