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Original Paper

Can Aid Improve People Health in Sub-Saharan African Countries?

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Abstract

This paper analyzes the effects of aid on health of people in Sub-Saharan African Countries. Used as health indicators for infant mortality rate, crude mortality rate and HIV/AIDS prevalence rate, this analysis uses panel data for a sample of 43 countries over the period of 1990 to 2014. Through assessing the effect of aid on reducing mortality and HIV prevalence, the article examines a central issue with regard to the new global development agenda: Can we still promote health through increased aid? The results tend to show that aid significantly reduces crude mortality and infant mortality rates and HIV/AIDS prevalence rate. They do not validate the presence of decreasing marginal returns. However, the impact of aid on health indicators is not linear. This non-linearity suggests that aid is more effective in reducing mortality and HIV prevalence in relatively poorest countries and in those with relatively lower health expenditure. Thus, health promotion in sub-Saharan African countries through increased aid is possible.

Keywords

aid effectiveness, health, direct effect, indirect effect, governance

1. Introduction

Since the success of the Marshall Plan, which has helped rebuild Europe in four years, Official Development Assistance (ODA) has been a major source of finance for poor countries. In this sense, the United Nations has made aid the preferred financial instrument for implementing the MDGs, and enhancing its effectiveness has long been the core program of the international community. With the implementation of Paris Declaration on aid effectiveness in 2005, the international community has continued to improve the impact of aid on development. However, poverty persists despite radical

changes in the development landscape.

As health is an important economic asset, it has been an important part in defining MDGs. Thus, over the 8 objectives, 3 focused on health: Reducing infant and child mortality; improvingmaternal health fight HIV/AIDS, malaria and other diseases. This particular focus is due to the precarious global health situation, especially in developing countries such as sub-Saharan Africa. According to the World Health Organization (WHO) statistics (2014), in developing countries, 1 in 10 children dies before the age of 5, and 500,000 women die each year in child delivery or during pregnancy.

In order to achieve these objectives, the international community has decided to make financial efforts in the form of ODA. Thus sub-Saharan Africa was able to benefit from external aid with a volume representing an average of 4.65% of its GDP over the period of 2000 to 2013. This aid allowed fundingabout 9.15% on average total health expenditure, from 6.5% in 2000 to 11.8% in 2011 (WHO, 2014). However as the MDGs are heading towards their end, health statistics show the expected results for 2015 will not be achieved in all regions of the world.

In this context, the effectiveness of this aid in terms of improving populations' health in sub-Saharan African countries is a central question. This question is important as the economic debate on the effectiveness of aid to poverty reduction is abundant. Indeed, there is considerable controversy in the economic literature about the link between aid and poverty reduction. While some authors argued that aid contributes to poverty reduction (Dollar et al., 2002; Dollar et al., 2013; Galiani et al., 2014; Hirano et al., 2014; Roemer et al., 1997), others, however, were sceptical about the ability of aid to reduce poverty (Akpo et al., 2006; Easterly, 2008; Easterly, 2003; Easterly et al., 2004, 2003; Knack, 2009; Moyo, 2009). As the economic literature has shown, health is a key determinant of poverty assessment indicators (Burnside et al., 1998; Chauvet et al., 2008; Gyimah-Brempong et al., 2008; Masud et al., 2005; Wolf, 2007).

Based on all the above, this paper is part of the debate on the effectiveness of aid, especially on the ability of foreign aid to contribute to improving people health in sub-Saharan African countries. The research hypothesis underlying the analysis in this paper, is that foreign aid has helped improve people health in these countries. And if this is the case, it is then possible to promote health through increasing aid. Being able to reach this conclusion is the main contribution of this paper. For this purpose, the paper is based on a review of literature, estimation models and analysis of results.

2. Health Effects of Aid: Literature Review

This literature review is organized around the following questions for this study:

2.1 Does Aid Have a Positive Effect on Health?

Looking through the empirical literature on this issue, most studies, to our knowledge, lead to the conclusion that aid has a positive effect on the health of populations.

In this idea, Wolf (2007) looked at the benefits of sector based aid on health, fresh water, sanitation and on education. Using cross-country data from 110 countries for 2002, he showed that aid allocated to

health significantly reduces infant and child mortality. In the same vein, Gyimah-Brempong and Asiedu (2008) also conducted GMM estimates on a panel of 90 countries with 3-year averages over the period of 1990 to 2004, and found a significant negative effect of aid allocated to health on infant mortality. These results mean that aid helps to improve people health (children) in these countries. Mishra and Newhouse (2009) confirmed these results by conducting a much more in-depth study on a panel of 118 countries between 1973 and 2004. They found that aid allocated to health significantly reduces infant mortality in these countries, but its effect was rather weak. A doubling of per capita health aid leads to a 2% reduction in infant mortality. The authors controlled endogeneity through the GMM estimator.

However, other studies lead to results that partially relativize the conclusions of previous authors. This is how Bokhari et al. (2007), in their analysis of the effectiveness of public health expenditure on people health, have shown that the effect of aid is insignificant, whatever the health indicator chosen (infant mortality rate or maternal mortality rate). Their study was based on cross-sectional data for 127 countries in 2000. In the same skepticism, Chauvet et al. (2009), based on an econometric assessment of inter and intra-country data on a sample of 109 developing countries covering the period of 1987 to 2004, showed that migrant remittances and aid significantly reduce infant and child mortality. However, this impact of health aid is non-linear, the latter being more effective in the poorest countries. The same authors, in a second econometric exercise, evaluated the respective effectiveness of migrant remittances and aid in reducing intra-country disparities on infant and child mortality rates. The results of this second exercise indicate that aid does not have a significant impact on these health indicators. Their study used arange of instruments, which made it possible to deal more effectively with the endogeneity of aid.

This synthesis shows that the question of the effect of the aid on health does not find a definitive answer. Although several authors highlight the positive effects of external aid on the health of populations, some studies conclude that there is negligible or no impact of aid.

2.2 Does Aid Have Indirect Health Effects Through Transmission Channels?

Most of studies analyze direct effect of aid obscuring the possibility that this effect is transmitted through other variables such as economic policies and the institutional environment. In health, for example, the rate of improvement in the health of populations is largely determined by changes in macroeconomic environment (Korachais, 2010). That is why, Chauvet et al. (2009) tested the existence of non-linearity in relationship between health aid and mortality indicators. This non-linearity is supported by the fact that the impact of health aid on the health indicators depends in particular on the constraints linked to the absorption capacity of aid by the recipient countries. These constraints can be captured by an interaction variable between aid and per capita income. Aid to health could thus be more effective in relatively richer countries because of their greater capacity to absorb aid. The results of their analysis do not validate the hypothesis of constraints to the absorption capacity. For Chauvet et al. (2009), the impact of aid is non-linear; this non-linearity, however, suggests that aid is more effective in reducing child mortality in relatively poorer countries.

Contrary to the authors who condition aid to good economic policies, others believe that aid could help cushion the harmful influence of macroeconomic instability on economic growth and social variables such as those of health. Indeed, Chauvet and Guillaumont (2004, 2009) showed that aid is more effective in countries which are vulnerable to exogenous shocks because it helps mitigate their negative effects on growth. As such, the stabilizing effect of aid is an important factor in its effectiveness on growth. More specifically, aid is more effective in vulnerable countries (climate and trade instability). Similarly, aid helps cushion the adverse effects of price shocks, in particular through counter-cyclical variations in foreign aid (Collier & Dehn, 2001).

2.3 Can We Still Promote Health Through Increased Aid?

This question draws its interest from the current debate on aid effectiveness because of mixed results in achieving the MDGs. Previous studies have supported this question through testing the non-linearity of relationship between aid and interest variables. The results show the possibility of diminishing returns of aid by pointing out problems related to "Dutch Disease" and/or limited absorption capacities (Durbarry et al., 1998; Hadjimichael et al., 1995; Heller et al., 2002).

Collier and Dollar (2002, 2001) introduced aid in a quadratic way to test the assumption of decreasing marginal returns of aid. Without this assumption, the optimal allocation of aid would be to allocate aid, first, to the country in which it is most effective, until there are no more poor in this country before moving on to the next country. The results of their estimates show a significantly negative effect of the quadratic term for aid; the coefficient of aid being, meanwhile, not significantly negative. These results call into question the hypothesis of diminishing returns that jointly requires a positive effect of aid and a negative effect of its square.

Chauvet et al. (2009) tested, in their study, this hypothesis of non-linearity of relationship between aid and health indicators by introducing aid in quadratic form in their basic model. A quadratic relationship between aid and health indicators would thus reflect the presence of decreasing marginal returns from aid. Beyond a certain threshold of aid received, any additional dollar is less effective because the recipient country does not have the capacity to absorb it optimally. However, the results of their estimates show that squared aid is not significant. Moreover, his sign is negative just like that of aid. The absence of a quadratic relationship between aid and mortality indicators thus confirms the absence of constraints on the absorption capacity.

3. Empirical Framework

Based on this economic literature, it is postulated that aid has a direct positive effect on people health. It can also be assumed that the relationship between aid and health indicators is non-linear. That non-linearity is observed through, on the one hand, the existence of transmission channels relative to the effects of aid on health indicators, and on the other hand, the presence of decreasing marginal outputs of aid. The idea of decreasing outputs evaluates the hypothesis that an additional volume of aid in health sector would improve the level of health in sub-Saharan African countries.

3.1 Analysis Model of Aid Direct Effects and Estimation Method

3.1.1 Basic Model

Inspired by analytical models used by Mishra et al. (2009) and Chauvet et al. (2009), in our analysis of effects of aid on health indicators, we use the following model:

$$lnHI_{i,t} = \alpha_0 + \alpha_1 lnX_{i,(t-1)} + \alpha_2 lnAid_{i,(t-1)} + \mu_i + \tau_t + \varepsilon_{it} \quad (1)$$

$HI_{i,t}$ represents health indicators in country i to period t. In reference to economic literature, the most commonly used health indicators in the analyzes are infant and child mortality rates (Bokhari et al., 2007; Chauvet et al., 2009; Gyimah-Brempong et al., 2008; Mishra et al., 2009; Wolf, 2007) and life expectancy (Mishra et al., 2009). In this analysis, *HI* is alternatively infant mortality rate and crude death rate. The main difference between these indicators is in the target population. The infant mortality rate represents the probability that a child born during a period will die before his first birthday. This probability is expressed per thousand births. As for crude mortality rate, it is extended to the entire population, regardless of the age of the individual. Like life expectancy, this indicator characterizes mortality regardless of age structure.

HI also represents other health outcome variables, such as mortality or morbidity related to tuberculosis or AIDS. These variables focus on particular morbidities, but are related to the quality of the health system to treat these diseases. But unlike Mishra et al. (2009) who considered these variables as exogenous in their analysis, our analysis considers them as endogenous variables because they are health indicators. They are interesting indicators to analyze because these diseases have led to the mobilization of huge resources of foreign aid.

All variables in the model are expressed in natural logarithms. Indeed, this expression of variables facilitates the interpretations of the results as well as the taking into account of some non-linearities (Chauvet et al., 2009).

$Aid_{i,t}$ represents aid received by country i in period t. The variable is delayed by one period to capture its effect on health indicators. Most studies on this issue focus on aid allocated to health sector (Chauvet et al., 2009; Gyimah-Brempong et al., 2008; Mishra et al., 2009; Wolf, 2007). These authors justified their choice of aid allocated to health because it would make it possible to better understand the impact of aid on health indicators. However, some types of aid are not directly intended for health sector, but indirectly contribute to the improvement of health indicators. For example, the aid for sanitation and fresh water, education and agriculture also contributes to improving health. This is why other authors introduced total aid into their model (Bokhari et al., 2007; Boone, 1996; Gomanee et al., 2005; Masud et al., 2005; Mosley et al., 2004). In this analysis, we will use both types of aid (by substitution). But beyond these two types of aid, some donors spend their funding almost exclusively on health. Of those, we can mention UNFPA, UNAIDS, WHO, etc. The idea is to introduce into the model aid flows from these donors to capture the effects. Aid is expected to improve the level of health indicators.

$X_{i,t}$ is a matrix of variables on the determinants of health status in country i at period t. These variables can be delayed by one period to capture their effect on health indicators. Economic literature identifies a number of variables which influence health indicators. For example, since the work of Ravallion (1993) and Prichett and Summers (1996), a consensus has emerged on the existence of a negative relationship between mortality and per capita income. Similarly, education has also been recognized as being negatively related to child mortality (Anand et al., 2004; Fay et al., 2005; Filmer et al., 1999; McGuire, 2006; Ravallion, 2007). Education variable is captured through school enrollment rate. Other determinants of health status have been identified in the literature, such as population size (Mishra et al., 2009) and public health expenditures (Chauvet et al., 2009). Finally, some authors have pointed out that health aid has more effect on reducing mortality in countries with good policies and institutional quality (Mishra et al., 2009). To these determinants are added other essential variables such as access to sanitation and access to fresh water that influence people health status.

3.1.2 Estimation Method

Several methods can be used to estimate equation (1). The fixed effects and variable effects model can be used. However, this technique does not evaluate the effect of aid because of difficulties in isolating exogenous components of aid in order to mitigate the effects due, for example, to the reciprocal influence of aid and health. Two potential sources of endogeneity may bias the estimated aid coefficients. First, aid is paid by donors for a specific purpose which may include improving health indicators. Although aid is determined at a macroeconomic level, it can to some extent, reflect people's chances of survival. Then, endogeneity can come from the existence of omitted variables that would affect aid and health indicators.

To do this, it is better to find good instruments in the regression. The empirical literature on aid effectiveness on growth suggests several instruments, including the dynamic character of the regression variables. To this end, the use of the Generalized Moment Method (GMM) estimator for a dynamic panel data model allows the specific effects of countries to be controlled while taking appropriate levels of lagged values (in level) for all potentially endogenous variables (Arellano et al., 1991; Arellano et al., 1995). The regression of equation (1) uses the GMM estimator in system (Blundell et al., 2000; Bond, 2002):

$$lnHI_{it} = \alpha_0 + \alpha_1 lnX_{i,(t-1)} + \alpha_2 lnAid_{i,(t-1)} + \gamma lnHI_{i,t-1} + \mu_i + \tau_t + \varepsilon_{it} \quad (2)$$

$$\Delta lnHI_{it} = \alpha_0 + \alpha_1(\Delta lnX_{i,(t-1)}) + \alpha_2(\Delta lnAid_{i,(t-1)}) + \gamma(\Delta lnHI_{i,(t-1)}) + \Delta\tau_t + \Delta\varepsilon_{it} \quad (3)$$

However, it is important to note that GMM estimators are increasingly criticized. One of the limitations of this estimator is the asymptotic weakness of its precision and that of the instruments that cause bias in the finished samples. Indeed, authors such as Roodman (2009), Bun and Windmeijer (2010) and Bazzi and Clemens (2013) showed that dynamic panel GMM estimators using instruments are sometimes unstable and potentially biased when the sample is limited; this is because of the problems related to the number and weakness of instruments.

It is for this reason that Blundell and Blond (2000) following Arellano and Bover (1995) proposed as solution the GMM estimator in system (Sys-GMM). This method made it possible to take into account all the sources of bias enumerated by instrumentalizing the independent variables with their delayed differences and with their delayed levels.

Equation (3) is estimated from a panel of 43 developing countries in sub-Saharan Africa over the period of 1990 to 2014. The data used in the analysis come from the World Bank database. Details of the countries concerned are given in Table 1 of appendix.

3.2 The Non-Linearity Model of Aid Effects

Starting from model (1), our analysis explores the relationship between aid and health indicators by testing non-linear nature of this relationship. Indeed, in the economic literature, some consensus has emerged regarding the non-linear effects of aid on macroeconomic performance (Burnside et al., 1998; Hansen et al., 2001; Lensink et al., 2001). Similarly, the effects of aid on health indicators are likely to be non-linear due in part to constraints related to the absorptive capacity of recipient countries. These constraints can be captured by a decreasing marginal yield test of aid (Collier et al., 2002, 2001; Gomanee et al., 2003a; Gomanee et al., 2003b; Hansen et al., 2001) or by a term of interaction between aid and other economic variables, economic or institutional policies (Alesina et al., 2000; Burnside et al., 2004, Burnside et al., 2000; Chauvet et al., 2009; Collier et al., 2002; Easterly et al., 2004).

To test the non-linearity, we extend the model (1) by specifying the following equations:

The first equation verifies the presence of decreasing marginal output through the introduction of the square of aid in model (4).

$$lnME_{it} = \alpha_0 + \alpha_1 lnY_{i(t-1)} + \alpha_2 lnAid_{i(t-1)} + \alpha_3 lnAid^2_{i(t-1)} + \mu_i + \tau_t + \varepsilon_{it} \quad (4)$$

The second equation tests the existence of transmission channels through economic and governance variables in the model (5).

$$lnME_{it} = \alpha_0 + \alpha_1 lnY_{i(t-1)} + \alpha_2 lnAid_{i(t-1)} + \alpha_3 lnAid_{i(t-1)} * lnV_{i(t-1)} + \alpha_4 lnAid_{i(t-1)} * lnG_{i(t-1)} + \mu_i + \tau_t + \varepsilon_{it} \quad (5)$$

Where lnAid*lnV is an interactive variable of aid with economic variables such as per capita income and public spending on health. The lnAid*lnG variable is an interactive variable of aid with a governance indicator. By governance we mean “traditions and institutions by which authority is exercised in a country for the common good. This includes the process by which governments are selected, controlled and replaced, the government’s ability to develop and implement sound policies, as well as respect for citizens and the state of institutions governing their economic and social interactions” (Kaufmann et al., 1999). Six aspects of governance are generally distinguished: the democratic nature of political institutions, political instability and violence, the effectiveness of public authorities, the weight of regulations, the rule of law, and finally the fight against corruption. In our analysis, we use the Corruption Control Index as a proxy for governance. The idea underlying the construction of this indicator is that all the corruption perceptions measure an identical underlying

concept of corruption. To aggregate these different corruption indexes, Kaufmann et al. (1999) used an extension of the "Standard Unobserved Component Model" that expresses a country's observed score for the Corruption Perception Index as a linear function of an unobserved common component of corruption. The perception index of corruption is the simple average of the scores thus obtained. This average is between 0 and 10; the higher it is, the more often corruption is perceived as infrequent.

These two equations are estimated using the same estimation techniques as those used for the basic model. The data used in the analysis also come from the World Bank database. They concern 43 countries in Africa and cover the periods of 1990 to 2014 and of 2000 to 2014. The choice of the period of 2000 to 2014 is constrained by the limit of the series of the governance variable (corruption control index).

4. Results

4.1 Descriptive Statistics

4.1.1 Health Indicators Profiles

In our analysis, three health indicators were used to assess their behavior in relation to aid: infant mortality rate, crude mortality rate and HIV/AIDS prevalence rate. Statistics show that, in sub-Saharan African countries, these indicators remain high compared to the rest of the world but have experienced a downward trend over the period of 1990 to 2014. As a result, infant mortality rate increased from 108.2‰ in 1990 to 56.7‰ in 2014. Crude mortality rate rose from 16.20 to 9.73‰ over the period. As for HIV/AIDS prevalence rate, its decline only occurred in the 2000s. Moreover, the downward momentum of these different rates has really begun since 2000, when the MDGs began to be implemented. In general, based on these statistics, there is every reason to believe that the implementation of the MDGs has reversed the trend of health indicators. Figure 1 shows in detail the evolutionary behavior of these health indicators over the period 1990-2014.

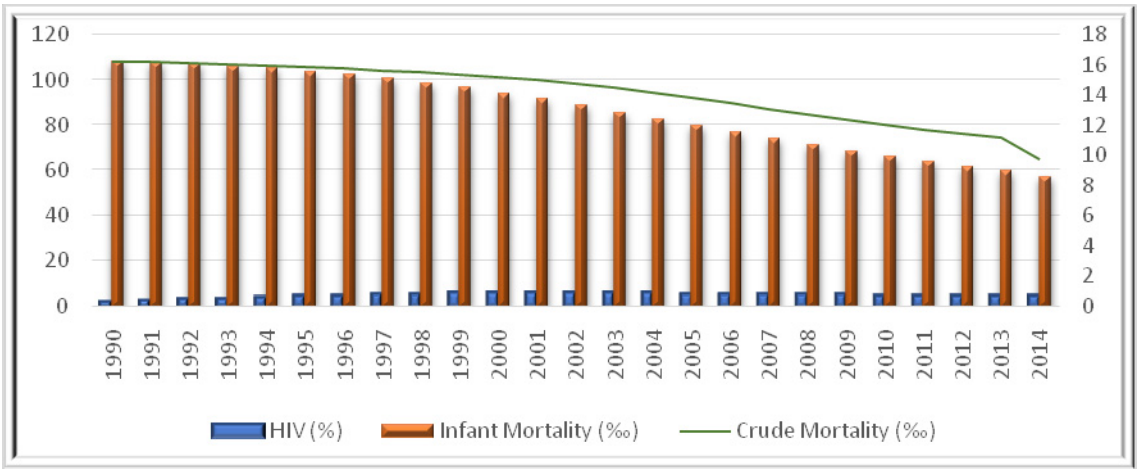

Figure 1. Mortality Rate (Crude and Infant) and HIV Prevalence Rate, 1990-2014

4.1.2 Aid Profile

Over the period of 1990 to 2014, aid flows received by Sub-Saharan African countries are estimated to average around 4.58% of their GDP. Aid to the health sector is estimated at an average of 0.10% of GDP over the same period. Figure 2 provides a detailed breakdown of the total aid and the aid to health over the period of 1990 to 2014. With regard to aid, there is a general downward trend over the analysis period. Indeed, it rose from 5.94% of GDP in 1990 to 2.92% in 2014, a decrease of 3.02 percentage points over the period. The same downward trend was observed on aid to health, which rose from 0.16% of GDP in 1990 to 0.03% in 2014, a decrease of 0.13 percentage points.

As noted above, some donors spend their funding almost exclusively on health. These donors include UNFPA and UNAIDS. UNFPA assistance accounted for an average of about 0.016 percent of Sub-Saharan Africa's GDP over the period of 1990 to 2014. For UNAIDS, information on its assistance is only available from 2005. This aid represented about 0.002% of GDP on average in these countries. The details on the evolution of these donors' aid are shown in Figure 3.

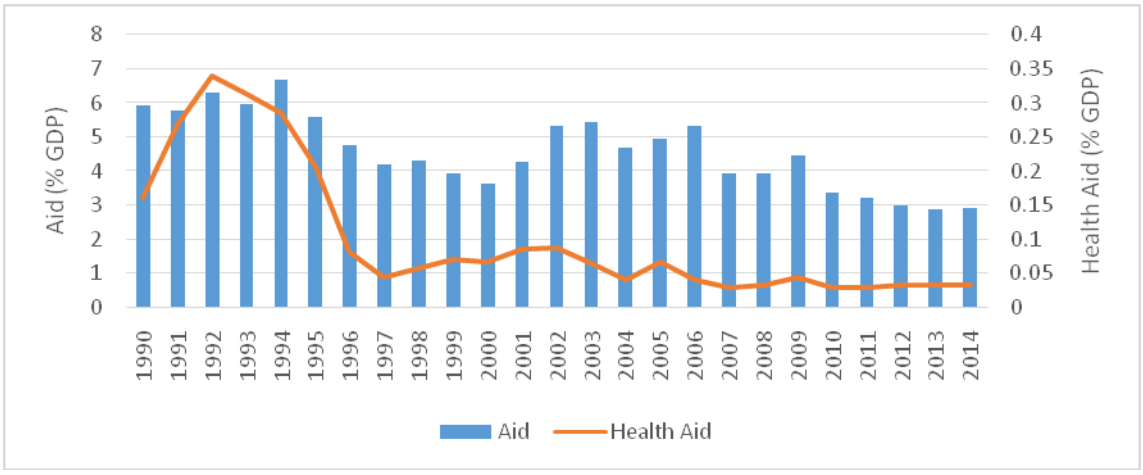

Figure 2. Evolution of the Total Aid, the Aid to Health Sector, 1990-2014

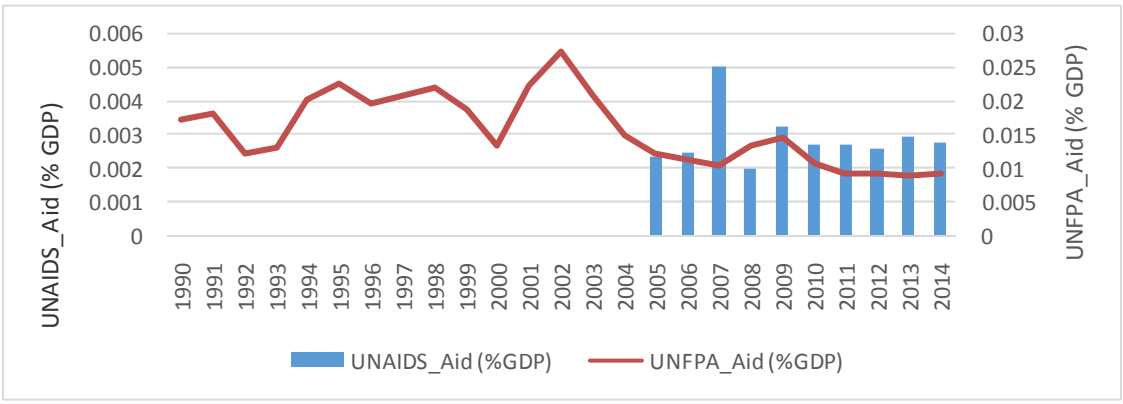

Figure 3. Evolution of UNFPA Aid, 1990-2014; UNAIDS Aid, 2005-2014

From this statistical analysis, it is noted that health indicators experienced a dynamic improvement over the period, especially from the 2000s. The profile of aid reveals rather a downward trend. These results seem contrary to expectations that improving health indicators would be influenced by increased aid. Econometric analysis will help to better understand the links between aid and these health indicators.

4.2 Econometric Estimation

In this sub-section, we examine the effects of aid on health indicators such as infant mortality rate, crude mortality rate and HIV/AIDS prevalence rate. First, through a basic model, we analyze the effects of the types of aid (the total aid, the health assistance, the aid from some donors specializing in health) on these health indicators. Then, in the estimates of non-linear models, we analyze the possibilities of the existence of thresholds and transmission channels of the effects of aid on health indicators.

4.2.1 Results of Basic Model Estimation

The regressions in Table 1 present the results of the baseline model estimate when the dependent variable is alternately infant mortality rate, crude mortality rate, and HIV/AIDS prevalence rate. Estimates are generally satisfactory and the results robust. Indeed, the diagnostic statistics are favorable in the sense that Hansen's over-identification test does not reject the validity of the instruments used and the Arellano and Bond test does not reject autocorrelation at order 2.

Table 1. Effects of Aid on Health Indicators: Basic Model Regressed Using GMM System Estimator

Variables	Infant Mortality			CrudeMortality			HIV		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
GDP_capita	-0.0008	-0.003	-0.0014	-0.008***	-0.0116*	-0.174*	-0.0166	-0.0130	0.008
	(-0.34)	(-1.25)	(-0.53)	(-2.39)	(-1.81)	(-1.69)	(-1.07)	(-0.90)	(0.70)
Education	-0.009**	-0.009***	-0.009**	-0.0001	-0.0061	-0.0102	-0.0251	-0.0315	0.0001
	(-2.27)	(-2.40)	(-2.33)	(-0.02)	(-0.68)	(-1.14)	(-1.11)	(-1.52)	(0.01)
Health_Expenditure	-0.006*	-0.011***	-0.007**	-0.0043	-0.0040	-0.0102*	-0.0068	-0.0315	-0.0131
	(-1.71)	(-2.95)	(-2.03)	(-0.64)	(-0.94)	(-1.65)	(-0.15)	(-0.62)	(-0.57)
Population	-0.146***	-0.150***	-0.146***	-0.007***	-0.080	-0.0339	-0.0139***	-0.019***	-0.0046
	(-7.63)	(-7.45)	(-7.68)	(-3.01)	(-1.42)	(-0.62)	(-2.80)	(-2.88)	(-0.74)
Fresh water	0.235	0.032	0.022	0.0192	0.0395	-0.00503	-0.0639	-0.0824	-0.0244
	(1.19)	(1.58)	(1.11)	(1.16)	(0.57)	(-0.05)	(-1.48)	(-1.59)	(-0.50)
Sanitation	-0.023**	-0.030***	-0.022**	-0.0013	-0.0422**	-0.0335	0.007	0.0218	0.0131
	(-2.15)	(-2.71)	(-2.03)	(-0.22)	(-1.94)	(-1.40)	(0.40)	(1.28)	(1.10)
Aid	-0.002**			-0.014***			-0.020***		
	(-1.93)			(-3.96)			(-2.49)		

Healthaid		-0.0002			-0.0041**			-0.0104*	
		(-0.21)			(-2.09)			(-1.72)	
UNFPA_aid			-0.0019*			-0.003***			
			(-1.73)			(-2.66)			
UNAIDS_aid									-0.0066
									(-0.91)
AR1 Test: P-value	0.033	0.013	0.033	0.072	0.052	0.035	0.014	0.01	0.071
AR2 Test: P-value	0.432	0.649	0.567	0.151	0.127	0.111	0.136	0.147	0.249
Number of Countries	37	37	37	39	37	37	39	39	37
Observations	327	314	328	415	314	328	413	406	190

Notes. (1), (2) and (3) Estimations using alternately total aid, health aid and aid from health donors (UNFPA, UNAIDS);

***, **, * Significant at 1%, 5% or 10% respectively; t-statistics in parentheses.

The results of different estimations in Table 1 indicate that aid improves health, contrary to the results of the Bokhari et al. (2007), which showed that aid effect is considered as insignificant, regardless of the chosen health indicator (infant-juvenile or maternal mortality rate). Indeed, total aid (% GDP) appears significant and is negatively associated with infant and child mortality rates and HIV prevalence rate. These regressions show that an increase 1% in aid reduces infant mortality rate by 0.002%, crude mortality rate by 0.014% and HIV prevalence rate by 0.02%.

However, if we disaggregate aid by sector, we find that health aid (% GDP) negatively associated with health indicators is significant only for crude mortality rate and HIV prevalence. An increase of 1% in health aid leads to a reduction in crude mortality of 0.0041% and HIV prevalence rate of 0.0104%. The insignificant effect of health aid coefficient on infant mortality rate corroborates the results of Chauvet et al. (2009) but is contrary to those of Mishra and Newhouse (2009).

In the same logic of disaggregation, the introduction in basic model of aid from donors specializing in health sector shows that UNFPA aid improves mortality rates. Indeed, a 1% increase of UNFPA aid reduces infant mortality rate by 0.0019% and crude mortality by 0.003%. On the other hand, the impact of UNAIDS aid on HIV prevalence is negative but not significant. It should be noted that there are other donors specializing in health, but only UNFPA and UNAIDS aid provides interesting results in our regressions.

To control variables, results of estimations show that the variables contributing to the reduction of mortality rates are per capita GDP, gross enrollment ratio, health expenditure, population size and access to sanitation. These results confirm other similar earlier results which indicate a negative relationship between mortality and per capita GDP (Prichett & Summers, 1996), education (Anand & al., 2004; Fay et al., 2005; Filmer et al., 1999; McGuire, 2006; Ravallion, 2007), population size (Mishra et al., 2009) and health expenditures (Chauvet et al., 2009). In contrast, for HIV prevalence,

only the size of the population appears to be significant in estimations and is negatively associated with HIV prevalence.

4.2.2 Analyzing Results of Estimations Non-Linear Model

The regressions in Tables 2 and 3 present the results ofnon-linear model estimation of aid effects when the dependent variable is alternatively infant mortality rate, crude mortality rate and HIV/AIDS prevalence. The estimates are generally satisfactory and the results robust. Indeed, the diagnostic statistics are favorable in the sense that Hansen's overidentification test does not reject the validity of the instruments used and the Arellano and Bond test does not reject autocorrelation at order 2.

Table 2. Effects of Aid on Health Indicators: Non-Linear Model (Threshold Effect) by GMM System Estimator

Variables	Infant Mortality			CrudeMortality			HIV		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
GDP_capita	-0.0010	-0.0034	-0.00137	-0.0109*	-0.0156**	-0.0124**	-0.0011	-0.0014	0.0081
	(-0.41)	(-1.18)	(-0.48)	(-1.84)	(-2.03)	(-2.17)	(-0.09)	(-0.09)	(0.64)
Education	-0.0090**	-0.009***	-0.0094**	-0.00018	-0.0059	-0.0017	-0.0248	-0.0405	0.0010
	(-2.22)	(-240)	(-2.32)	(-0.03)	(-1.18)	(-0.25)	(-1.11)	(-1.27)	(0.04)
Health_expenditure	-0.0060*	-0.011***	-0.0074**	0.00226	-0.00763	-0.0113**	-0.0164	0.0151	-0.0122
	(-1.63)	(-2.95)	(-2.02)	(0.29)	(-1.59)	(-1.96)	(-0.81)	(0.44)	(-0.49)
Population	-0.144***	-0.151***	-0.146***	-0.0068***	-0.0447	-0.0191	-0.0104*	-0.0185***	-0.0039
	(-7.48)	(-7.45)	(-7.59)	(-2.62)	(-1.30)	(-0.59)	(-1.94)	(-3.08)	(-0.66)
Fresh_water	0.224	0.0330	0.0219	0.1560	-0.0049	-0.0209	-0.0654*	-0.1847***	-0.0155
	(1.13)	(1.60)	(1.11)	(1.01)	(-0.11)	(-0.41)	(-1.67)	(-2.71)	(-0.34)
Sanitation	-0.0247**	-0.031***	-0.0225**	0.00126	-0.0289*	-0.0356	0.0102	0.0327*	0.0189*
	(-2.23)	(-2.73)	(-2.03)	(0.26)	(-1.85)	(-1.37)	(0.67)	(1.85)	(1.70)
Aid	-0.0054*			-0.0183*			-0.0116*		
	(-1.82)			(-1.85)			(-1.81)		
Aid_squared	-0.0005			-0.0005			-0.0007		
	(-1.22)			(-0.42)			(-0.75)		
Health_aid		-0.0017			-0.0124**			-0.0012	
		(-0.42)			(-2.42)			(-0.04)	
Health_aidsq		-0.00010			-0.0005**			0.0004	
		(-0.38)			(-2.16)			(0.29)	
UNFPA_aid			-0.0019*			-0.0133***			
			(-1.73)			(-2.73)			
UNFPA_aidsq			-0.000006			-0.0006**			

			(-0.09)			(-2.17)			
ONUSIDA_aid									-0.1003**
									(-1.97)
UNAIDS_aidsq									-0.0046*
									(-1.79)
AR1 Test: P-value	0.033	0.013	0.033	0.071	0.028	0.033	0.013	0.011	0.066
AR2 Test: P-value	0.458	0.646	0.569	0.139	0.11	0.121	0.227	0.209	0.258
Numberof countries	37	37	37	39	37	37	39	39	37
Observations	327	314	328	415	314	328	412	406	190

Notes. (1), (2) and (3) Estimations using alternately total aid, health aid and aid from health donors (UNFPA, UNAIDS);

***, **, * Significant at 1%, 5% or 10% respectively; t-statistics in parentheses.

Table 3. Effects of Aid on Health Indicators: Non-Linear Model by GMM System Estimator

Variables	Infant Mortality			Crude Mortality			HIV		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
GDP_capita		-0.0036	-0.0002		-0.0197***	-0.0026		-0.0100	0.0142
		(-1.26)	(-0.06)		(-2.64)	(-0.60)		(-0.79)	(0.68)
Education	-0.0104***	-0.0099***	-0.0156	-0.0155	-0.0080	0.0088	-0.0239***	-0.0286*	0.0089
	(-2.51)	(-2.41)	(-1.49)	(-1.13)	(-0.98)	(1.02)	(-4.70)	(-1.65)	(0.18)
Health_expenditure	-0.0123***		-0.1006	-0.0164***		-0.0050	-0.0239***		-0.0084
	(-3.08)		(-0.91)	(-2.80)		(-0.45)	(-3.62)		(-0.11)
Population	-0.1509***	-0.1512***	-0.0081***	-0.0570	-0.0109	-0.0071***	-0.0161***	-0.0170***	-0.0006
	(-7.45)	(-7.47)	(-2.66)	(-1.18)	(-0.21)	(-3.29)	(-7.05)	(-2.99)	(-0.06)
Fresh_water	0.0354*	0.0320	-0.0104	0.0296	-0.0275	0.0109	-0.0608***	-0.0633***	0.0026
	(1.72)	(1.56)	(-0.52)	(0.46)	(-0.30)	(0.48)	(-6.61)	(-2.71)	(0.03)
Sanitation	-0.0308***	-0.0305***	0.0028	-0.0247	-0.0711	0.0018	0.0152***	0.0152	0.0086
	(-2.72)	(-2.70)	(0.36)	(-0.63)	(-1.42)	(0.31)	(3.96)	(1.14)	(0.87)
Health_aid	-0.005**	-0.003**	-0.0035	-0.0186***	-0.0061***	-0.0094***	-0.0178***	-0.0149*	-0.0034
	(-1.97)	(-2.13)	(-0.98)	(-3.55)	(-2.96)	(-4.47)	(-3.04)	(-1.83)	(-0.28)
Health_aid*GDP_capita	0.0007**			0.0022***			0.0011**		
	(2.19)			(3.57)			(2.07)		
Health_aid*Health_expenditure		0.0016***			0.0011*			0.0018	
		(3.12)			(1.88)			(0.65)	
Health_aid*governance			0.00002			0.0026**			0.0039
			(0.01)			(2.13)			(0.74)

AR1 Test: P-value	0.014	0.012	0.297	0.083	0.026	0.06	0.001	0.009	0.038
AR2 Test: P-value	0.677	0.64	0.313	0.146	0.119	0.701	0.353	0.114	0.252
Numberof countries	37	37	33	37	37	33	39	39	33
Observations	314	314	181	314	314	181	406	406	181

Notes. (1), (2) and (3) Estimates by alternately introducing cross-health aid with per capita GDP, health expenditure and governance;

***, **, * Significant at 1%, 5% or 10% respectively; t-statistics in parentheses.

The results of the non-linear model allow for testing assumptions of decreasing marginal aid outputs and indirect influence of aid on health indicators through per capita income and health expenditure.

Table 2 provides test results for the assumption of decreasing marginal outputs of aid. These results do not support this hypothesis that the introduction of quadratic variable of aid into the model maintains the sense of relationship between health indicators and aid. Admittedly, squared aid is never significant in our regressions, regardless of the indicator, but the squared aid to health crossed with aid from health donors is significant and negatively related to health indicators. Indeed, the coefficients of aid to health on quadratic form and aid from UNFPA appear significant and are negatively associated with crude mortality rate. Likewise, the coefficient of aid from UNAIDS on quadratic form shows a similar result associated with HIV/AIDS prevalence rate. Thus, unlike Chauvet et al. (2009), who did not find a significant result, our results show that the sign of aid does not change and that the squared aid to health and that coming from UNFPA and UNAIDS are significant. These results suggest that, in our sample, there is no threshold of aid received beyond which any additional aid is less effective. In other words, the countries do not face any capacity constraints for absorption of aid.

The results in Table 3 verifies the hypothesis of aid channels relative to aid effect on health indicators. These results do not validate the existence of constraints to absorption capacity of aid. While aid impact is non-linear; this non-linearity suggests that aid is more effective in reducing mortality and HIV prevalence in relatively poorest countries and in those where health expenditure is relatively lower. These results are consistent with those found by Chauvet et al. (2009) who showed that the effect of aid is non-linear, but this non-linearity suggests that aid is more effective in reducing child mortality in relatively poorest countries.

In our analysis, by comparing aid to health with per capita GDP, we see that the negative effect of health aid disappears and is significantly associated with the three health indicators selected. The same is true for cross-health aid with health expenditure. But the significant effect is only associated with mortality rates. For health aid in interaction with governance, the result is significant only at the level of effect associated with crude mortality rate. This last result suggests that aid is more effective in reducing crude mortality rate in countries where governance (control of corruption) is weak. Such an outcome is unexpected in that it runs counter to the results of many authors who conclude that aid is more effective in terms of economic growth and poverty reduction in countries with good institutions

and economic policies (Alesina et al., 2000; Burnside et al., 2004; Burnside et al., 2000; Chauvet et al., 2009; Collier et al., 2002; Easterly et al., 2004).

5. Conclusion

Although aid effectiveness is strongly criticized in economic literature (Moyo, 2009; Easterly, 2003, 2004, 2008, Easterly et al., 2003), microeconomic results of aid tend to demonstrate its effectiveness at this scale. Aid programs for a specific sector of economy may have significant benefits for this sector without their macroeconomic effects being clearly discernible. It is in this sense that we can perceive the interest of this article which made a sector-based analysis of foreign aid received by the developing countries. The analysis focused on the determinants of crude, infant and HIV/AIDS prevalence rates in order to assess the effect of aid on health. It has been built around the assumption that foreign aid has a positive direct effect on the health of populations and that the relationship between aid and health indicators is non-linear.

The estimated results indicate that foreign aid has a positive effect on people health and appears consistent with aid effectiveness literature. Indeed, the coefficient of aid appears to be significant and is negatively associated with infant and child mortality rates and HIV prevalence rate. And if we disaggregate aid, the results show that health aid associated negatively with health indicators is significant for both crude mortality rate and HIV prevalence rate. Aid coming from UNFPA contributed to reducing mortalityrate.

As for the hypothesis of non-linearity of the relationship between aid and health indicators, the results do not validate the presence of decreasing marginal returns because the introduction of aid in quadratic form in the model maintains the sign of the relationship between health indicators and aid. Besides, the results of the model to test the presence of channels of transmission of aid effects on health indicators do not validate the existence of constraints to absorption capacity of aid. While the effect of aid is non-linear, and this non-linearity suggests that aid is more effective in reducing mortality and HIV prevalence in relatively poorest countries and in those where health spending is relatively lower.

With the adoption by the United Nations of the new development agenda (Sustainable Development Goals), these results suggest that health promotion in these developing countries through increased aid is possible. International institutions specializing in health, in collaboration with national authorities, can play a central role in allocating and using aid to improve health indicators.

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Appendix 1

Sample of Countries Involved in This Study

N°	Pays	N°	Pays	N°	Pays
1	South Africa	16	Gambia	30	Nigeria
2	Angola	17	Ghana	31	Ouganda
3	Benin	18	Guinea	32	Rwanda
4	Botswana	19	EquatorialGuinea	33	Sao Tome and Principe
5	Burkina Faso	20	GuineaBiseau	34	Senegal
6	Burundi	21	Kenya	35	Sierra Leone
7	Cameroun	22	Lesotho	36	Somalia
8	Cabo Verde	23	Liberia	37	Soudan
	Democratic				
9	Republic of Congo	24	Madagascar	38	Swaziland
10	Republic of Congo	25	Mali	39	Tanzania
11	Cote d'Ivoire	26	Mauritania	40	Chad
12	Djibouti	27	Mozambique	41	Togo
13	Eritrea	28	Namibia	42	Zambia
14	Ethiopia	29	Niger	43	Zimbabwe
15	Gabon				