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Does Official Development Assistance for health from developed countries displace government health expenditure in Sub-Saharan countries?

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Abstract

This paper empirically examines the foreign aid fungibility in the health sector of 45 Sub-Saharan countries over the period of 1995-2012. The aim of the study is to investigate the effect of foreign health aid on government health expenditure by using two methods: the Generalized Method of Moments (GMM) and the Fixed Effect Instrumental Variables (FE-IV). The estimation was conducted on the full sample and on two sub samples: middle- and low-income countries. We found strong evidence of partial fungibility in the health sector as follows: an increase of 1% in health aid leads to an increase of 0.04 to 0.1% of government health spending, noting that the magnitude of fungibility in middle-income countries is higher than in the low-income ones.

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1. Introduction

The development of the African health sector has once again become a priority for African governments and the international community. Ensuring a healthy lifestyle and promoting the wellbeing for all people is the third sustainable development goal of the United Nations by 2030. Despite the fact that the main health indicators (such as life expectancy and mortality rate) in the fragile health situation in Sub-Saharan African Countries (SSAC) have slightly improved due to the effects of economic development, the commitment of states and the support of their partners (donor countries, multilateral agencies, foundations and NGO's), the SSAC still suffer from a poor and vulnerable health care system, and have lately witnessed high concerns related to infectious diseases such as AIDS, Malaria and Ebola.

According to the World Health Organization (2014), the life expectancy has increased significantly by 9 years on average in the poor countries from different regions in the world (from 51.2 to 60.2 years and 54 to 63.1 years for men and women respectively) over the period of 1999-2012. In Sub-Saharan countries, the top three that made the greatest progress in extending life expectancy were Liberia (by 19.7 years) followed by Ethiopia and Rwanda. This progress is mainly caused by the reduction of child deaths and deaths from infectious diseases (WHO 2014). However, other SSAC such as Botswana, South Africa, Lesotho and Swaziland still face many challenges to extend the level of life expectancy (Ssozi and Amlani 2015). In 2001, the African Union dialogue decided that the government expenditure for health should not be less than 15% of the government budget as a clear criterion to enhance the health sector (WHO 2010). In this context, Official Development Assistance (ODA) may play an important role in increasing the resources to finance health care sector and improving health outcomes in these countries. Nonetheless, beneficiary countries may use these funds for another purpose, which arises the issue of fungibility of aid. Foreign aid is said to be fungible "*when government offsets donor spending for a particular purpose by reducing its own expenditures on the same purpose*" (Foster and Leavy 2001. p.14). "Total fungibility" of aid happens when there is no increase of public spending in the targeted sector, and "partial fungibility" is when this increase is less than the aid provided.

Although SSAC have received three times more aid than other regions (Devarajan *et al*. 1999), the outcomes from foreign aid are mixed, and the fungibility may be one of the reasons of its ineffectiveness. The fungibility and volatility of foreign aid coupled with the difficulties that developing countries face in reallocating resources may lead to the opposite result anticipated by donors and recipients (Gottret and Schieber 2006). Therefore, when fungibility occurs, the assessment of the effectiveness of aid to the health sector is more difficult. In this case, measuring and understanding the fungibility issue is important for accomplishing international communities and donor's goals.

Little is known about the aid fungibility in the health sector in the SSAC region. Given the shortage of empirical studies that investigate this issue, this paper provides additional evidence from SSAC using a dynamic panel data analysis of fungibility. To the best of our knowledge, Devarajan *et al*. (1999) and Ssozi and Amlani (2015) are the only empirical studies that focused on the African countries. The first study used only concessionary loans as aid variable for 18 Sub-Saharan countries excluding the grants, which represent two thirds of the aid sector. The second study covered 44 SSAC from 1995 to 2011, but without distinguishing between middle- and low- income countries. In this context, this paper contributes to the empirical literature in several aspects, as follows. The researchers test the hypothesis of the fungibility of the foreign aid for the health sector using a dataset of 45 SSAC over the 1995-2012 period, and use two different econometric estimators, GMM-SYS and FE-IV, to investigate the relationship between the government health expenditure and foreign aid in a dynamic model. Another highlight of this study includes the consideration of the endogeneity of aid, a factor ignored in most of the previous studies. Given the potential heterogeneity issue existing between the different SSAC and the significant developments of foreign health aid that occurred in some of these countries, the sampling method tried to fill a significant gap in the empirical literature by dividing the main sample into two sub-groups (middle-income and low-income) identifying the magnitude of fungibility in both. Finally, the empirical model contains a rich set of control variables, such as demographic indicators (total population, population over 65 years, population less than 5 years) and health status (HIV/Aids and Tuberculosis) to capture the other possible determinants of government health expenditure.

The outline of this paper is as follows: sections 2 and 3 present a brief literature review and descriptive analysis on fungibility in SSAC, sections 4 and 5 describe the empirical methodology and discuss the results. Finally, section 6 states the main conclusions and policy implications.

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2. Literature Review on Aid Fungibility

The review of the literature shows that there is no consensus on the existence of aid fungibility and the results of the related empirical studies are inconclusive. By using annual data for 14 developing countries in the period of 1971-1990, Feyzioglu *et al*. (1998) found that foreign aid is not fungible at the aggregate level, yet, their investigation of the sectoral aid fungibility revealed different results: while the concessional loans to transport and communication sectors are not fungible, opposite result appears on education, agriculture and energy sectors. However, when the sample size was increased to include 38 countries, 11 of which from SSAC, they found that the foreign aid is fungible i.e. one dollar of foreign aid increases spending of the recipient government by 33 cents. These results, which the World Bank also used in its report "Assessing Aid", were criticized[1] two years later by Lensink and White (2000) and McGillivray and Morrisey (2000).

Using a sample of 107 countries (including 35 SSAC) over the period 1970-2000, Pivovarsky *et al*. (2003) found that grants had been fungible despite the positive effect of concessional loans on domestic financial resources. Furthermore, Chatterjee *et al.* (2007) showed strong evidence of fungibility by using a panel of 67 countries (including 17 SSAC) over 1972-2000. This result infers that an increase in one dollar is associated with $0.30 increase in government spending, which means that $0.70 of every dollar of foreign aid is fungible. Pettersson (2007) used panel

[1] Lensik and White (2000) criticized Feyzioglu *et al*. (1998) study due to their use of small sample and of the concessionary loans, thus excluding grants, which constitute the vast bulk of bilateral aid. Furthermore, McGillivray and Morrissey (2000) provide also a critical discussion about the robustness of their result.

data analysis for 57 countries (including 17 SSAC) from 1974 to 2001 to examine the impact of foreign aid on different sectors. He found that foreign aid is fungible and over 65% of sectorial foreign aid tend to be diverted to donor's preferences.

In the health sector, the literature also provides mixed results on the foreign aid fungibility. Devarajan *et al*. (1999) focused on African countries where the fungibility was expected to cause the ineffectiveness of aid. Using a panel data of 18 countries for the period 1971 to 1995, they found that the aid was partially fungible; a one dollar increase in external funds caused government expenditure to increase by $0.90. Masud and Yontcheva (2005) using a panel of 58 countries (including 40 SSAC) from 1990 to 2001 revealed that bilateral aid might be fungible. In contrast, Mishra and Newhouse (2007) found different results by using a panel of 118 countries (including 39 SSAC) from 1973 to 2004. According to their results (expressed by per capita), doubling ODA for health is associated with a 7% increase in public health expenditure. Their estimated results imply that a one dollar increase in donor's funding is associated with more than $1.50 increase in health spending**.**

In the same vein, Farag *et al*. (2009) showed that a 1% increase in health aid lead to a decline by 0.19%, 0.09% and 0,027% in the government health spending for low-income countries, lower-middle-income and upper-middle-income countries, respectively. Lu *et al.* (2010), through a panel study for developing countries, from 1995 to 2006, found that official development assistance for health sector was fungible only when it was channeled through the government sector. On the contrary, different results were obtained when aid was conducted through non-government sectors. Recently, Ssozi and Amlani (2015) have used a panel from 1995 to 2011 for 43 SSAC and found that an increase in foreign health aid of $1 would reduce government health expenditure by up to about $0.01.

The studies that analyze an individual country are also non-conclusive, similar to those in the panel studies. Pack and Pack (1990, 1993) found that ODA is fungible in the Dominican Republic, non-fungible in Indonesia and partially fungible in Sri Lanka. Mavrotas and Ouattara (2006) showed that aid is not fungible in Philippines, Costa Rica or Pakistan. Finally, Dodd *et al.* (2010) have recently found that donor's health projects for Vietnam were partially fungible: a 10% increase in donor health projects was associated with a 1.86% decrease in general government expenditure on health.

Table I shows a summary of the literature of different empirical studies on the existence and the magnitude of fungibility at the micro and macro level.

Table I. Summary

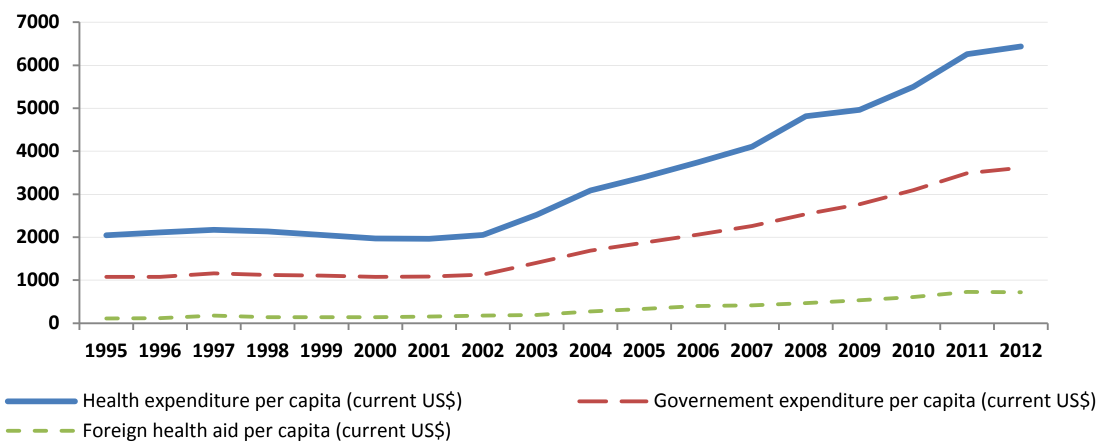
Author	Sample and period	Result
Macro-level		
Ssozi and Amlani (2015)	43 SSAC, 1995-2011	• High degree of fungibility: an increase of $1 in foreign health aid would reduce government health expenditure by $0.01
Feyzioglu *et al.* (1998)	38 countries, 1971-1990.	• High degree of fungibility 67% of aid flows are used to reduce the budget deficit and / or taxes
	14 countries, 1971 - 1990	• Low degree of fungibility, 1 dollar of aid increases spending by 95 cents.
Chatterjee *et al.* (2007)	67 countries 1972 - 2000	• 0.70$ of every dollar of ODA is fungible
Pettersson (2007)	57 countries -1974 - 2001	• Sectorial aid is fungible
Pivovarsky *et al.* (2003)	107 countries 1970 - 2000	• Grants flows are fungible
Cashel-Cordo and Craig (1990)	46 countries, 1975 -1980	• Foreign aid has had a stimulatory effect on public spending
Devarajan *et al.* (1999)	18 SSAC, 1971 - 1995	• A partial fungibility of aid
Lu *et al.* (2010)	Developing countries, 1995 - 2006	• Fungible when it was channeled through government sector • Not fungible when it was channeled through no-government sector.
Farag *et al.* (2009)	Developing countries, from 1992-2006.	• In low-income countries, A 1% increase in health aid, government spending on health decreased by 0.19% • In upper-middle income countries; 0,027% • In lower-middle income countries 0.09%
Masud and Yontcheva (2005)	58 countries 1990 - 2001	• Bilateral aid is fungible
Pack and Pack (1990)	Indonesia from 1966 to 1986	• Aid is not fungible
Pack and Pack (1993)	Dominican Republic,1986 - 1986	• Aid is fungible
Dodd *et al*. (2010)	Vietnam, 1995 - 2007	• a 10% increase in aid projects for health, leads to a reduction in general government spending on health by 1.86%
Mishra and Newhouse (2007)	118 countries. 1973 - 2004	• 1 $ increase in health aid per capita leads to more than US$1.50 increase in government health spending (per capita).
Mavrotas and Ouattara (2006)	Philippines, Costa Rica and Pakistan	• Aid is not fungible
Micro-level		
Shiffman (2007)	From 1992 to 2005	• Shiffman.j found that donor prioritization in terms of fighting against HIV/AIDS in developing countries was displacing foreign aid for other health issues.

3. Brief Descriptive Analysis on Fungibility in SSAC

The analysis classified the studied sample into two main groups building on the World Bank (2014) country classification. The first group includes the low-income countries where the GNI per capita is equal or less than \$1,045. The second group is composed of the middle-income countries where the GNI per capita is between \$1,045 and \$12,746.

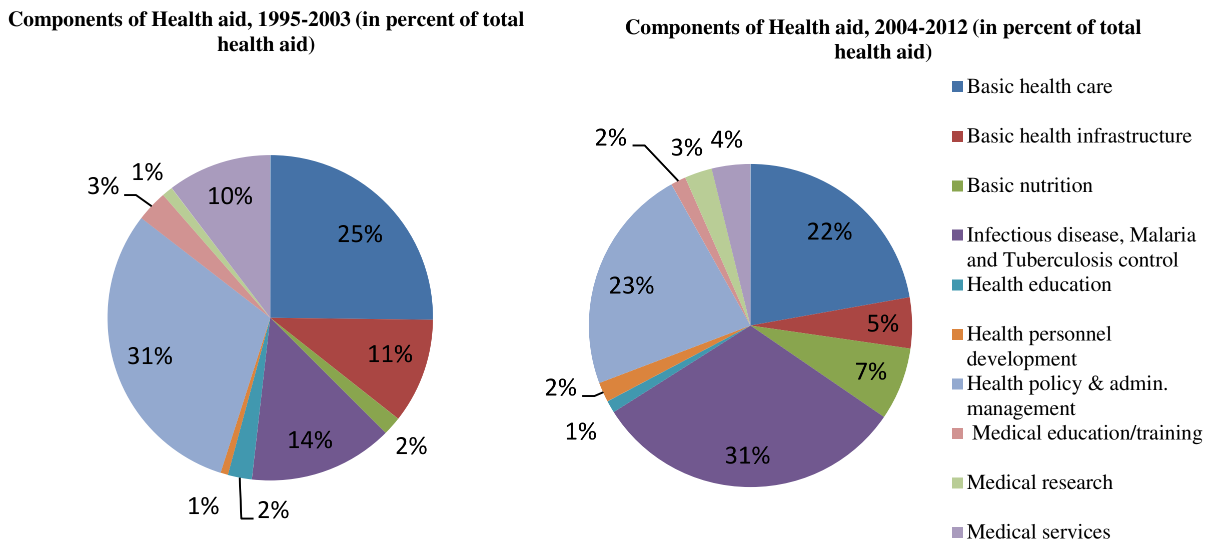
Figure 1 shows the evolutions of the government expenditure per capita, the health expenditure per capita and foreign health aid per capita, during the 1995 to 2012 period. This figure shows that these three indicators were stable over the 1995-2001 period. After 2003, the health expenditure and foreign health aid witnessed a considerable increase in SSAC. This trend shows an important awareness campaign regarding infectious diseases threatening developing and donor countries, driven mainly by the creation of the Global Fund to fight against AIDS, Malaria and Tuberculosis in 2002[2]. Figure 2 provides further evidence on this trend, where the foreign aid allocated to the infectious diseases control has substantially increased from 14% between 1995-2003 to 31% between 2004-2012. The executed efforts to fight against the infectious diseases are considered a global public good (Kaul *et al.* 1999, Barrett 2007, Sandler 2002) and no country is really protected from the spread of contagious diseases. In general, the protection measures against these diseases implemented by each country are insufficient, and thus the closure of airports and borders or the creation of stocks of medicines cannot alone prevent the spread of diseases. As the fight against infectious diseases is classified as "weakest-link" (Barrett 2007), the participation and the cooperation of all countries is needed to produce this type of public good. The funding of health through ODA would allow developed countries to help poor countries fight against these diseases and consequently ensure their own protection. In this case, the provided public good "weakest-link" is often associated with positive- sum games, the "win-win" type of games (Severino and Tubiana 2002).

Figure1. The evolution of the government expenditure, the health expenditure and foreign health aid (in current US\$, per capita)



[2] According to Gottret and Schieber (2006) many partnerships and philanthropies have contributed in the increase of funds intended to fight against infectious diseases such as: the Global Fund (GFATM), the Global Alliance for Vaccines and Immunization, Roll Back Malaria, and the U.S. President's Emergency Plan for AIDS Relief. Their contribution represented roughly 15% of total health aid in 2002 and 20% in 2003.

Figure 2. The components of health aid for the 1995-2003 and 2004-2012 period (in percent of total health aid).



However, the fungibility of foreign aid may leads to underfunding the provision of this type of public goods and health sector in general. Before proceeding to the regression analysis that investigates the relationship between key variables, it is instructive to have a brief comparison of the evolution of foreign health aid and government health expenditure between low-income and middle-income SSAC. Table II shows the average per capita of real GDP, the average per capita of total health expenditure, the average per capita foreign health aid, the government health expenditure as percent of total health expenditure and the foreign health aid as percent of total health expenditure for the three sub-periods 1998–2002, 2003-2007 and 2008-2012. The government health expenditure as percent of total health expenditure increases slightly from 53.40% in 1998-2002 to 55.46% in 2008-2012 in low-income countries, while it remains stable near to 59% in middle-income countries. Table II shows also that foreign health aid as percent of total health expenditure increases for low- and middle-income countries from 17% and 5.6% between 1998-2002 to 32% and 7.4% between 2008-2012 respectively.

Table II. Real GDP, total health expenditure and foreign health aid in 45 SSAC from 1998-2012 (per capita, in constant 2005 US$).

Country group	Average per capita real GDP	Average per capita total health expenditure	Average per capita foreign health aid	Government health expenditure as % of total health expenditure	Foreign health aid as % of total health expenditure
Low- income 24 Countries					
1998-2002	1599	88	15	53.40%	17.04%
2003-2007	1732	100	26	56.00%	26%
2008-2012	1922	119	39	55.46%	32.77%
Middle- income 21 countries					
1998-2002	12673	585	33	59.31%	5.64%
2003-2007	15385	698	44	57.44%	6.30%
2008-2012	17493	905	67	59.77%	7.40%

4. Data, Model and Methodology

4.1 Data

The dataset used in this paper is collected from diverse sources. The World Health Organization (National Health Accounts (NHA)), the Creditor Reporting System (CRS) of OECD and the World Bank. Our empirical analysis uses annual panel data of 45 Sub-Saharan African countries (see appendix 1) observed over the period of 1995-2012. This provides us with a number of observations equal to N*T=765 where N is the number of countries and T is the number of years. The dataset includes the following variables: foreign health aid, government expenditure on health, income and some other control variables.

Foreign Health Aid (FHA): the data of foreign health aid comes from the Creditor Reporting System (CRS) of OECD. The OECD provides data on ODA commitments by purpose of aid, which signifies the sector of the recipient's economy that the aid activity is designed to assist (OECD definition) such as education, health or peace. The foreign health aid represents the sum of ODA for health provided to finance the basic health expenditure and the general health.

Government Expenditure (HEX): our main data source of government expenditure on health is the National Health Accounts (NHA) of WHO. The data are expressed on constant $2005 per capita.

*Income (RGDP)***:** the real GDP per capita measures the income level of the country. In the literature, GDP per capita has been identified as a major determinant of health care expenditure. We expect a positive and significant correlation between these two variables as indicated in the literature (Kleiman 1974, Newhouse 1977, Leu 1986, Getzen 2000, Xu *et al.* 2011, Angko 2013).

The control variables: other variables are included in the estimated equation, total population (POP) (Devarajan *et al*. 1999, Mishra and Newhouse 2007), population over 65 years old (POP+65) to examine the effect of an aging population on government health spending (Xu *et al* 2011) and infant population less than 5 years (POP-5) to control for infants and Children. We expect a positive relationship between these three variables of population and the government health expenditure.

On the other hand, disease pattern such as infectious disease, tend to have a strong impact on the amount and types of health services in Sub-Saharan countries (Xu *et al*. 2011). Given the missing data related to Ebola and Malaria, our empirical study uses the Tuberculosis rate (TUB) and HIV/AIDS as indicators to capture the dominance of disease. In addition, further control variables are included in the estimation such as the infant mortality rate (MRATE), as a proxy for the population health status (Angko 2013), the government effectiveness[3] (GE) and the private health spending (PRI) which includes private insurance, out of pocket expenditure and non-profit institutions serving households (e.g. NGOs).

4.2 Model

To estimate the effect of real GDP, foreign aid and the other explanatory variables on government health spending, we use a linear dynamic model where the health expenditure is a

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[3] We also add an interaction term between foreign health aid and government effectiveness. Which means that countries that have an improvement in government effectiveness may have a more effective allocation of health aid

dependent variable and the real GDP and foreign health aid are independent variables with some other control variables. Moreover, in order to better understand the dynamics of adjustment of the health expenditures, we include a lagged dependent variable among the regressors. The inclusion of this lagged value is highly intuitive since the current budget is prepared in the previous year which makes government considers this lagged relation when deciding on how much to spend on healthcare in the current year. Therefore, our empirical analysis will base on the following model:

$$\boldsymbol{LHEX_{it} = \alpha_1 + \alpha_2 LHEX_{i,t-1} + \alpha_3 LFHA_{it} + \alpha_4 LRGDP_{it} + \beta LX_{it} + \gamma_t + \tau_i + \varepsilon_{it}} \qquad \textbf{(1)}$$

Where L is the logarithmic operator, $LHEX_{it}$ represents the logarithm of government expenditures on health, $LFHA_{it}$ is the logarithm of foreign health aid and LRGDP_{it} is the logarithm of real GDP. LX_{it} and γ_t are a set of controls and year dummy variables, respectively. τ_i represents recipient's country fixed effects and ε_{it} is an error term. 'i' denotes a country, while the 't' is time. In this model, α_3 is the main parameter of interest which is expected to be positive and less than one when countries depend on the foreign aid to finance their health sectors, which means that aid is partially fungible. Whereas, aid is non-fungible if α_3 is positive and equal to one. On the contrary, the expected sign of α_3 could be negative when countries diverted foreign aid to non-health sectors which indicates a strong degree of fungibility.

The real GDP coefficient α_4 is expected to have a positive sign. If the value of α_4 lies between 0 and 1, health care is claimed to behave like a necessity commodity, whereas if α_4 is greater than 1, it is considered as a luxury commodity (Gerdtham and Jonsson 2000).

One of the important issues when estimating dynamic equation like eq. 1 is the identification of the links between the foreign health aid, per capita real GDP, the government health expenditure and the other control variables. The correlation of LHEX with an omitted characteristic of a country could lead to biased results and overestimated effects. To deal with this problem, we introduce a country fixed effect (τ_i) and time-specific effect (γ_t) in the equation (1).

4.3 The Empirical Methodology

To investigate the fungibility in SSAC our empirical methodology was based on the estimation of the dynamic eq.(1) using dynamic panel data methods.

4.3.1 Endogeneity Test

A potential issue in the estimation of eq.(1) that can be highlighted is the possible endogeneity of two variables. The first variable that is endogenous is $\mathrm{LHEX}_{\mathrm{i,t-1}}$ because of its correlation with $\varepsilon_{\mathrm{it}}$. The second variable that is endogenous is the foreign health aid. The intuition behind the possible cause of this endogeneity includes the existence of unobservable factors varying in time and not captured by fixed-effects. Failing health systems or governments, anticipated shifts in other disease burdens or the potential for conflict in the countries are likely to be correlated with aid-flows (omitted-variable bias). Furthermore, the existence of a possible reverse causality between the government health expenditure and the foreign health aid variables implies that it is difficult to perceive foreign health aid as being independent of the level of government health expenditure in the recipient country. Moreover, a simultaneity bias may be observed, given that countries that spend more in health are more likely to have a superior foreign health aid. To verify this intuition, a test for endogeneity will be conducted. However, in our database, no exogenous variable can play the role of an instrument variable for the foreign health aid variable.

A possible solution to this problem is to use the lagged of the endogenous variable by one year as instrumental variables.

4.3.2 Method of Estimation

The inclusion of the lagged dependent variables ($LHEX_{i,t-1}$) in the right side of the eq. (1) makes the OLS fixed effect estimation biased and inconsistent. To overcome this problem, we use two different methods of estimation: the fixed effect with instrumental variable estimator (FE-IV) and the General Moment Method estimator (GMM-SYS) developed by Blundell and Bond (1998). The first estimator method allows a consistent but not necessarily efficient estimation of the coefficients because it does not make use of all available moment conditions and does not take into account the differentiated structure of the residual disturbances (Baltagi 2001).

The FE-IV method consists of estimating eq.(1) in levels. Unfortunately, the FE-IV procedure does not exploit all available lags and does not consider the structure of the errors, and one can argue that this estimator is less efficient. However, in recent studies, several researchers have used the generalized moment method (GMM-DIFF) of Arellano Bond (1991) to estimate dynamic models. The advantage of this method is that it includes more instruments of all previous level values of the lagged dependent variables (GMM-DIFF estimator). But the GMM-DIFF estimators have been found to be weaker than their true values if there is a strong persistence in the investigated time series and if cross-section variability dominates time variability (Bond *et al*. 2001). Blundell and Bond (1998) developed a new method that improves efficiency and provides a robust estimator, called GMM-SYS. It is based on the assumptions that the error term is not serially correlated. Thus, disturbances in the equations are uncorrelated with the instrumental variables, which are the lagged levels of the series after the equation has been first-differenced to eliminate country-specific effects (Blundel and Bond 1998). This method deals with endogenous variables, autocorrelation and unobserved country-level heterogeneity (Roodman 2009a). The GMM-SYS method is more efficient in the presence of highly persistent dependent variables such as the lagged government health expenditure. In this study, we use the FE-IV and GMM-SYS methods to estimate eq. (1) and we use the first lag of the endogenous variables as instruments.

The first step when conducting estimation with instrumental variables is to verify whether those instruments are highly correlated with the endogenous variable. For the FE-IV to select and test the suitability of the instruments, two criteria based on the relevance and the validity of the instruments are employed. When these two criteria are not satisfied, the instrument is said to be weak, and the FE-IV estimates coefficients are biased (see Staiger and Stock 1997). Instrument relevance requires that each instrument should be highly correlated with the endogenous regressor. The instrument relevance can be tested empirically using the test of Bound *et al*. (1995), which can be implemented in the presence of endogenous regressor. This test is implemented as an F-test of the joint significance of the instruments in the first-stage regression. However, Staiger and Stock (1997) note that the problem of weak instruments can arise even when the null hypothesis of zero partial correlation can be rejected at conventional levels of significance (5% or even 1%) and regardless of the sample size. As a rule of thumb, they suggested that a value of F-test greater than 10 should lead to the conclusion that the instruments are relevant. In this paper, we respected this simple rule in our assessments of instrument relevance. The second criterion is the validity of instrument, which means the absence of a relationship between the instrument variable and the idiosyncratic error. In the case of an exact identification model, instrument validity is not testable. However, in the case of over-identifying restriction, instrument validity can be tested with the Sargan statistic or the Hansen J-statistic. To simplify the evaluation of our estimation results, for each model and estimator, we explicitly state the assumptions that guarantee instrument validity and whether the model was identified.

For the GMM-SYS method the AR(1) and AR(2) tests were always performed to confirm the validity of the adopted specifications. Moreover, we report the results of the Sargan tests of over-identifying restrictions to verify the overall validity of the GMM instruments. The null hypothesis suggests that the instruments are uncorrelated with some set of residuals.

5. Empirical Results

The results of endogeneity test for the suspected foreign health variable are presented in the bottom of the tables III, IV and V. Under the null hypothesis that the specified endogenous regressor can actually be treated as exogenous, the test statistic is distributed as chi-squared with degrees of freedom equal to the number of regressors tested. As shown by the statistics, we can say that foreign health aid is endogenous in our sample.

Before we begin our discussion of the results we check the validity and the relevance of the instruments variables. Regarding the FE-IV estimation method we use two tests the Cragg-Donald test (Wald-F) and the Anderson test. The Anderson test confirms that the instrumental variables used in all estimations are relevant. Also, the value of the Cragg-Donald tests indicates that the instruments are valid. The values of F-statistics are above the informal threshold of 10 suggested by Staiger and Stock (1997). For the GMM-SYS estimations, the reliability of instruments was checked based on the values of AR (1) and AR (2) of Arelano and Bond (1991). The absence of autocorrelation of order 2 means that we can use the second order lag and higher of the dependent variable as instruments in the GMM-SYS estimation. All the results in table III, IV and V show the presence of AR (1) and the absence of AR (2).

Tables III, IV and V show the empirical results of FE-IV and GMM-SYS methods that describe the relationship between the government health expenditure and the explanatory variables. The estimated results show a positive and statistically significant effect of foreign health aid on government health spending for all cases. In the case of full sample (table III) an increase of 1% in health aid leads to an increase of government spending on health between 0.04% and 0.1%. In the case of middle-income countries and low-income countries, tables IV and V, the association between foreign health aid and government spending varies from one group to another. In low-income countries, a 1% increase in foreign health aid was associated with an average increase equal to 0.13% in government health expenditure. However, the effect was smaller in middle-income countries, where a 1% increase in foreign health aid leads to an average increase by 0.05% in government funding for health. Therefore, our results show evidence for partial fungibility of health aid in both middle- and low-income countries. While the relationship between external funding and government spending on health is positive and significant, the donors funding through aid has been accompanied by a very small increase in public expenditures for health. We found also that fungibility is higher in middle-income countries than in the low-income countries. These different results could be explained by the higher amount of foreign aid delivered to the health sector in the middle-income countries (around 300 million US$ on average between 2002-2012) compared to low-income countries (192 million US$). The annual average growth rates of foreign health aid[4] between 2002-2012 in middle-income countries was 12% and, 10% in low-income countries. Moreover, other factors driving fungibility could explain this result, such as volatility of donor aid, capacity of absorption, number of donors, timing, preferences of donors and recipients, and aid modalities (general budget support/project aid) (Lahiri *et al*. 2004, Leiderer 2012, Gottret and Schieber 2006, OECD-DAC 2006).

Regarding the real GDP per capita, as expected, the coefficient is also positively associated with government health spending and statistically significant for full sample (table III). However, SSAC are not homogenous because of the existence of different health care provisions and different financing sources. Consequently, investigating the income elasticity for low and middle- income countries is of great interest. Tables IV and V show that the income elasticities for low- and middle-income countries are positive and statistically significant. The results show also that the coefficients estimated of the government's income are less than one, which means that health is considered as a necessary good in Sub-Saharan countries rather than a luxury. These results are consistent with Murthy and Okunade (2009) and Vasudra and Albert (2009). For middle- and low-income countries a 1 % increase in real GDP leads to an average increase by 0.2% and 0.51 % in public health expenditure, respectively.

The results from tables III, IV and V show also the estimated coefficients of the remaining HEXP determinants. For the variables used as proxy of population: the total population (estimations 1 and 4 in the tables), the population over 60 years (estimations 2 and 5 in the tables) and population less than 5 years (estimations 3 and 6 in the tables), the empirical results show that all population proxies have a significant and positive effect on health expenditure. In particularly, population has a significant and positive impact for both lower-income countries and middle-income countries. These findings are contradictory to some previous studies such as Mishra and Newhouse (2007) and Xu *et al*. (2011) where the demographic structure variables seem to be of no significance. For the variables that control the disease pattern the results show that both the Tuberculosis prevalence (estimations 1, 2 and 3 in the tables) and HIV/AIDS (estimations 4, 5 and 6 in the tables)[5] are associated with government health expenditure in all cases. Its effect is positive and significant, which means that governments allocate more resources to health in response to high Tuberculosis or HIV/AIDS diseases. Similarly, the results of all estimation show the infant mortality rate has a positive and significant effect for the full sample and for the two sub-samples. Regarding the government effectiveness variable, the results show a statistically significant effect on health expenditure in the full sample and the two sub-samples. However, the sign of this effect is not unique across countries. The relationship between government effectiveness and government health expenditure was positive for the middle-income countries. This finding implies that the improvement of GE in middle-income countries may lead to more health expenditure. Moreover, the positive coefficient of the interaction term between foreign health aid and GE implies that good governance is an important factor to better allocate this aid to the health sector. On the contrary, the correlation was negative between government effectiveness and government health expenditure in low-income countries. Although this result may seem counterintuitive, it can be explained by the fact that the

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[4] Authors calculation.

[5] We estimate also the same equation by including Malaria as proxy of disease pattern, but the results are non-significant. Moreover, this variable contains many missed data.

improvement of GE in these countries may have led to the improvement of health outcomes (decrease of the infant and child mortality rates or improvement of life expectancy at birth), which can cause a decrease in funds intended to the health sector. Also, some funds were simply embezzled to other sectors.

Table III. Dynamic estimation for full sample GMM-SYS and FE-IV

Independent Variables	**Dependent Variable (LHEX)** GMM-SYS						FE-IV					
	1	2	3	4	5	6	1	2	3	4	5	6
LHEX$_{t-1}$	0.78***	0.73***	0.74***	0.7***	0.78***	0.77***	0.69***	0.70***	0.71***	0.60***	0.71***	0.62***
	(16.18)	(15.82)	(17.7)	(14.1)	(15.03)	(16.35)	(20.7)	(21.37)	(21.5)	(12.7)	(21.5)	(12.8)
LRGDP)$_t$	0.34***	0.29***	0.5***	0.59***	0.57***	0.6***	0.11*	0.14	0.093	0.13*	0.088*	0.12*
	(5.4)	(2.58)	(5.72)	(4.6)	(4.84)	(5.5)	(1.70)	(1.12)	(1.16)	(1.68)	(1.72)	(1.66)
LFHA$_t$	0.062***	0.04***	0.049***	0.069***	0.073***	0.073***	0.10***	0.12***	0.09***	0.101***	0.1***	0.104***
	(3.3)	(2.76)	(3.43)	(3.5)	(4.00)	(4.37)	(3.93)	(4.24)	(3.6)	(4.13)	(4.10)	(3.79)
LPOP	0.042***			0.045***			0.067*			0.033*		
	(3.1)			(3.3)			(1.78)			(1.72)		
LPOP+65$_t$		0.29*			0.05			0.39*			0.36**	
		(1.68)			(0.14)			(2.23)			(2.12)	
LPOP-5$_t$			0.039***			0.033***			0.031			0.07
			(3.76)			(3.28)			(0.23)			(0.50)
LTub$_t$	0.36***	0.47***	0.3***				0.052*	0.047*	0.012			
	(2.91)	(3.62)	(3.37)				(1.77)	(1.85)	(1.02)			
LHIV$_t$				0.057*	0.059*	0.058*				0.017	0.014	0.013*
				(1.7)	(1.75)	(1.75)				(0.4)	(1.2)	(1.68)
LGE$_t$	0.19**	0.095*	0.04				0.014	0.016	0.018			
	(2.16)	(1.71)	(1.04)				(0.34)	(0.38)	(0.42)			
*LFHA*GE*				0.0053*	0.0013	0.003				0.0037 *	0.001	0.0014
				(1.84)	(0.14)	(0.84)				(1.7)	(0.4)	(0.48)
LPRI$_t$	-0.021*	-0.081	-0.18***	-0.3 ***	-0.33***	-0.35***	-0.044*	-0.043	-0.036	-0.04	-0.041	-0.042
	(-1.72)	(-1.05)	(-2.62)	(-3.1)	(-3.8)	(-3.9)	(-1.76)	(-0.38)	(-0.88)	(-0.96)	(-1.04)	(-1.03)
LMRATE$_t$	0.32**	0.31***	0.19***	0.18**	0.148*	0.17*	0.16	0.28**	0.025	0.019	0.057	0.09
	(3.89)	(3.86)	(2.81)	(1.95)	(1.67)	(1.95)	(0.14)	(2.15)	(0.24)	(0.18)	(0.77)	(0.99)
N of observation	763	763	763	729	729	729	675	675	675	645	645	645
Sargan Test (p-value)	0.14	0.17	0.125	0.212	0.822	0.432						
AR(1)	-10.83	-11.17	-11.21	-9.86	-9.90	-9.65						
	(0.000)	(0.000)	(0.00)	(0.000)	(0.000)	(0.000)						
AR(2)	0.7	-0.31	0.15	0.51	0.45	0.61						
	(0.452)	(0.75)	(0.87)	(0.58)	(0.65)	(0.542)						
Wald F statistic (Cragg-Donald)							97.5	98.5	123.7	115.08	124.7	88.77
LM statistic (Anderson canon. corr.)							154.4	156.6	183.30	174.1	183.33	140.35
Endogeneity test							10.382	11.89	7.50	7.75	11.01	10.4
							(0.0013)	(0.006)	(0.0061)	(0.006)	(0.0041)	(0.005)
The Durbin-Wu-Haussman endogeneity test based on $\chi2(1)$= 3.84 statistic.												

*p-values are in parenthesis , *** significant at 1 %. ** significant at 5 % , * significant at 10 %. The regressions include period dummies.*

Table IV. Dynamic estimation for Low-income Countries GMM-SYS and FE-IV

Independent Variables	Dependent Variable (LHEX)											
	GMM-SYS						FE-IV					
	1	2	3	4	5	6	1	2	3	4	5	6
LHEX$_{t-1}$	0.75 ***	0.77***	0. 758***	0.76***	0.79***	0.72***	0.52***	0.50***	0.43***	0.44***	0.43***	0.47***
	(10.41)	(12.6)	(12.51)	(17.3)	(17.35)	(18.3)	(7.37)	(6.36)	(4.14)	(4.37)	(3.22)	(4.56)
LRGDP)$_t$	0.48**	0. 16	0. 430**	0.45**	0.38*	0.49***	0.54**	0. 34*	0.69**	0.66**	0.62**	0.65**
	(2.45)	(0.73)	(2.25)	(2.44)	(1.66)	(2.66)	(1.97)	(1.68)	(2.3)	(2.42)	(2.31)	(2.42)
LFHA$_t$	0.14***	0.13***	0.143***	0.112***	0.101**	0.15***	0.45***	0. 5***	0.62***	0.57***	0.55***	0.51***
	(5.00)	(4.19)	(4.89)	(3.66)	(2.36)	(4.6)	(4.45)	(4.62)	(3.93)	(3.98)	(4.18)	(4.05)
LPOP	0.061***			0.01			0.6*			0.51		
	(2.6)			(0.45)			(1.75)			(0.64)		
LPOP+65$_t$		0.31			0.25***			0.31*			0.35*	
		(0.45)			(2.6)			(1.68)			(1.78)	
LPOP-5$_t$			0.020**			0.014**			0.11			0.13*
			(2.44)			(2.66)			(0.59)			(1.76)
LTub$_t$	0.25***	0.21***	0.23***				0.082	0.13	0.099			
	(3.98)	(3.13)	(3.83)				(1.09)	(1.54)	(0.24)			
LHIV$_t$				0.071*	0.074**	0.01*				0.015	0.013	0.017*
				(2.01)	(2.07)	(1.74)				(0.22)	(1.2)	(1.77)
LGE$_t$	-0.17**	-0.12*	-0.125**				-0.13***	-0.16***	-0.17***			
	(-2.43)	(-1.67)	(-2.45)				(-3.02)	(-3.23)	(-3.03)			
*LFHA*GE*				-0.018**	-0.017**	-0.12**				-0.012*	-0.013**	-0.011*
				(-2.23)	(-2.13)	(2.35)				(-1.78)	(-2.01)	(-1.75)
LPRI$_t$	-0.18***	-0.072	- 0.17***	-0.143**	-0.10*	-0.16**	-0.29***	-0.32***	-0.45***	0.43***	-0.46***	-0.44***
	(-2.89)	(-1.07)	(-2.71)	(-1.97)	(-1.68)	(-2.27)	(-2.69)	(-2.79)	(-2.8)	(-2.88)	(-2.99)	(-2.99)
LMRATE$_t$	0.63***	0.30*	0.616***	0.28*	0.30*	0.35**	0.52**	0.78***	0.9***	0.75**	0.91***	0.78***
	(4.1)	(1.91)	(3.93)	(1.87)	(1.74)	(2.54)	(2.28)	(2.94)	(2.8)	(2.49)	(2.89)	(2.60)
N: of observation	405	405	405	390	390	390	381	381	367	367	367	367
Sargan Test	1.394	1.616	1.5	1.9	0.345	1.3						
AR(1)	-7.61	-8.15	-7.53	-7.8	-8.30	-8.18						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.00)	(0.000)						
AR(2)	-0.91	-1.06	-0.81	-0.62	-0.79	-0.64						
	(0.37)	(0.29)	(0.416)	(0.53)	(0.43)	(0.52)						
Wald F statistic (Cragg-Donald)							21.92	18.82	13.4	12.3	12.89	13.12
LM statistic (Anderson canon. corr.)							41.32	36.7	22.81	25.8	25.51	26.1
Endogeneity test							30.8	28.6	27.9	28.07	29.46	28.2
							(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
The Durbin-Wu-Haussman endogeneity test based on $\chi 2(1)$= 3.84 statistic.												

*p-values are in parenthesis , *** significant at 1 %. ** significant at 5 % , * significant at 10 %. The regressions include period dummies*

Table V. Dynamic estimation for middle income countries GMM-SYS and FE-IV

Independent Variables	**Dependent Variable (LHEX)**											
	GMM-SYS						FE-IV					
	1	2	3	4	5	6	1	2	3	4	5	6
$LHEX_{t-1}$	0.47***	0.55***	0.48***	0.44***	0.502***	0.46***	0.66***	0.64***	0.4***	0.32***	0.42***	0.38***
	(7.4)	(6.33)	(7.40)	(6.10)	(7.1)	(6.81)	(10.8)	(11.02)	(3.61)	(2.7)	(3.57)	(3.90)
$LRGDP)_t$	0.15*	0. 14*	0.16**	0.27***	0.31***	0.22***	0.19**	0. 18***	0.24***	0.12*	0.19***	0.20*
	(1.95)	(1.81)	(1.99)	(3.43)	(4.53)	(3.59)	(2.50)	(2.67)	(3.7)	(1.67)	(2.79)	(2.58)
$LFHA_t$	0.042**	0.05***	0.049***	0.033*	0.064***	0.098*	0.02*	0.033*	0.039***	0.074**	0.052*	0.067**
	(3.53)	(3.19)	(4.27)	(1.77)	(4.6)	(1.69)	(1.80)	(1.88)	(2.92)	(2.15)	(1.75)	(2.10)
LPOP	0.065 *			0.030*			0.106			0.84**		
	(1.77)			(1.79)			(0.38)			(2.44)		
$LPOP+65_t$		0.046*			0.025***			0.055			0.020*	
		(1.70)			(4.13)			(0.77)			(1.72)	
$LPOP\text{-}5_t$			0.037*			0.022**			0.058*			0.14*
			(1.93)			(2.02)			(1.67)			(1.81)
$LTub_t$	0.33***	0.22***	0.39***				0.071*	0.09*	0.106**			
	(3.45)	(5.18)	(4.93)				(1.67)	(1.75)	(2.38)			
$LHIV_t$				0.056*	0.013*	0.059*				0.16**	0.127**	0.14**
				(1.95)	(1.71)	(1.90)				(2.35)	(2.37)	(2.28)
LGE_t	0.050**	0.046*	0.048*				0.023*	0.031	0.028			
	(2.09)	(1.79)	(1.81)				(1.71)	(1.05)	(0.36)			
*LFHA*GE*				0.0073*	0.0023	0.008*				0.005*	0.0045*	0.0035
				(1.69)	(1.15)	(1.73)				(1.81)	(1.8)	(0.75)
$LPRI_t$	0.33***	0.24***	0.31***	0.32***	0.29***	0.28***	0.10***	0.12**	0.13***	0.094*	0.104*	0.11**
	(4.5)	(3.81)	(4.10)	(3.06)	(3.36)	(3.08)	(2.61)	(2.15)	(2.70)	(1.75)	(1.95)	(2.09)
$LMRATE_t$	0.055	0.106*	0.13*	0.22**	0.32***	0.23**	0.092	0.070	0.064	0.38*	0.34**	0.23*
	(0.83)	(1.68)	(1.69)	(2.44)	(3.35)	(2.42)	(0.67)	(0.56)	(0.53)	(1.77)	(2.58)	(1.74)
N: of observation	355	355	355	338	338	338	335	335	335	300	300	300
Sargan Test	1.31	0.90	6.14	1.4	2.77	4.1						
AR(1)	-7.12	-6.74	-6.40	-6.05	-6.56	-6.18						
	(0.000)	(0.000)	(0.000)	(0.00)	(0.000)	(0.00)						
AR(2)	0.28	0.80	0.36	0.80	0.92	0.97						
	(0.83)	(0.42)	(0.71)	(0.42)	(0.3)	(0.33)						
Wald F statistic (Cragg-Donald)							113.172	68.5	40.829	13.27	21.2	16.01
LM statistic (Anderson canon. corr.)							128.92	129.41	90.82	25.94	38.9	30.605
Endogeneity test							30.8	25.47	21.30	21.065	20.71	24.2
							(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

The Durbin-Wu-Haussman endogeneity test based on $\chi2(1)$= 3.84 statistic.

*p-values are in parenthesis , *** significant at 1 %. ** significant at 5 % , * significant at 10 %. The regressions include period dummies.*

6. Conclusion

This paper, using a sample of 45 Sub-Saharan countries from 1995–2012, has confirmed empirically that aid for health was partially fungible. This means that the increase in donors funding was associated with a small increase in government health expenditure in the studied countries. The results show a positive and significant coefficient of foreign health aid for the full sample and for the two income country groups (low- and middle-income countries). However, our result shows that the magnitude of the foreign health aid coefficients varies from one group to another. More precisely, Health aid is more fungible in middle-income countries than low-income countries. This study also measures the degree of the income elasticity of health expenditure in our sample. The results have shown that health in sub-Saharan countries is a necessary good rather than a luxury good. The results also show for SSAC that, in addition to the income factor, the control variables such as the age structure of the population (population over 65 years old and infant population less than 5 years), infant mortality rate, Tuberculosis rate and HIV/AIDS play a role as determinants of government health spending.

In terms of policy implications, it is very important to take into account the degree of fungibility in order to determine the best channels and forms of aid allocation (budget support or off-budget funding). Even though there is no consensus on the best instrument of aid to use in the presence of fungibility, some studies point out that budget support is more appropriate than off- budget funding when the degree of fungibility is higher (Farag *et al*. 2009). Furthermore, one of the main reasons of fungibility are the conflicting preferences between donors and recipients. In this case, aligning donor's priorities with recipient government's needs by reducing the asymmetric information may reduce aid fungibility and consequently improve aid effectiveness. Finally, the SSAC should focus on the improvement of their government effectiveness and corruption control to make government health expenditure and foreign aid for health more effective. On the other hand, donors should make their funding less volatile and coordinate their actions, especially when the number of donors is high in the recipient country.

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Appendix 1.

List of 45 SSAC in analysis	
Angola	Lesotho
Benin	Liberia
Botswana	Madagascar
Burkina Faso	Malawi
Burundi	Mali
Cabo Verde	Mauritania
Cameroon	Mauritius
Central African Republic	Mozambique
Chad	Namibia
Comoros	Niger
Congo, Dem. Rep.	Nigeria
Congo, Rep.	Rwanda
Cote d'Ivoire	Sao Tome and Principe
Equatorial Guinea	Senegal
Eritrea	Seychelles
Ethiopia	Sierra Leone
Gabon	South Africa
Gambia, The	Sudan
Ghana	Swaziland
Guinea	Tanzania
Guinea-Bissau	Togo
Kenya	Uganda
	Zambia