ORIGINAL RESEARCH

Does health sector aid matter? Evidence from time-series data analysis in Ethiopia

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Abstract

Aims: Development assistance for health is an important part of financing health care in developing countries. In spite of the increasing volumes in absolute terms in development assistance for health, there are controversies on their effect on health outcomes. Therefore, this study aims to analyze the effect of development assistance for health on health status in Ethiopia.
Methods: Using dynamic time series analytic approach for the period 1978-2013, this paper examines whether development assistance for health has contributed for health status change in Ethiopia. While life expectancy at birth was used as a measure of health status, vector error correction model was used for the analysis.
Results: Development assistance for health expenditure (lagged one and two years) had a significant positive effect on life expectancy at birth in Ethiopia. Other things being equal, a 1% increase in per capita development assistance for health leads to 0.026 years improvement in life expectancy at birth (P<0.001) in the immediate year following the period of assistance, and 0.008 years (P=0.025) in the immediate two years following the provision of assistance.
Conclusion: This study indicates that, seemingly, development assistance for health has significant favourable effect in improving health status in Ethiopia. The policy implication of this finding is development assistance for the health should continue as an interim means to an end.

Keywords: development assistance, health financing, health status, infant mortality rate, life expectancy.

Conflicts of interest: None.

Introduction
There is paucity of evidence on the effects of development assistance on health outcomes in developing countries. Within the limited literature on the issue, there is disagreement on its effect. Some researchers argue that health specific aid leads to improved health outcomes in developing countries by relaxing resource constraints and directly improving health service delivery (1-3). In line with this, Levine (1) argues that health is an area where development assistance is likely to show positive changes, as preventive and promotive health activities are directly related to the better health outcomes. The empirical studies by Mishra and Newhouse, and Ebeke and Drabo (2,3) also report strong positive effect of health aid on health outcomes in improving infant mortality rate and access to health care for the treatment of fever and diarrhoea respectively in developing countries. Chauvet, Gubert and Mesple-Somps (4), who analyzed the respective impact of aid and remittances on infant and child mortality rates with a panel data from 1987 to 2004, also reported results suggesting a positive effect of health aid on health outcomes. Similarly, Gormanee, Girma, and Morrissey reported that aggregate aid improves health status by decreasing infant mortality in least developed countries (5).

On the contrary, some other scholars argue that there is no reliable evidence supporting the claimed positive effect of health aid on health outcomes (6,7). Williamson (6), for example, looked into the impact of foreign aid commitments by donor to health sector using a panel set of 208 developed and developing countries with data from 1973 to 2004 and found no significant impact of health sector aid on a variety of health outcome indicators (including infant mortality and life expectancy at birth). Similarly, Wilson (7), using panel data of 96 countries with high mortality during 1975-2005, tested the relationship between development assistance for health and a recipient country's Infant Mortality Rate (IMR). His empirical analysis suggests that development assistance for health has no effect on infant mortality at the country level.

Although Sub-Saharan Africa including Ethiopia is among the largest recipients of development assistance (8), the relationship between such assistance and health outcomes has not been properly investigated. Ethiopia has been receiving increased inflow of development assistance following its implementation of the Health Sector Development Plan (HSDP) (9). During 2009 and 2010, the country received the second highest volume of average development assistance in absolute terms among 24 low and lower-middle income countries, while in 2011, it was the first recipient among these countries (10). As a result, the country's National Health Account (NHA) show development assistance as contributing to 50% of the general health care spending in the year 2010-2011, up from 40% during 2007-2008 (11).

Parallel to the increase in development assistance, health outcomes in the country have also shown noticeable changes during the last two and half decades (11,12).Under-five Mortality Rate (U5MR) is reduced by two thirds between 1990 and 2015, and the country has achieved MDG4 two years before the target year (11-13). The Ethiopian Demographic and Health Survey (EDHS) reports of 2000, 2005 and 2011 also show declining trends in both U5MR and IMR (14-16), even though changes in neonatal mortality rate were not as impressive (14-16).

In this context, the present study aimed to explore whether the aforementioned improvements in health outcomes are partly attributed to an increase in inflow of development assistance.

Methods

The theoretical model
Using dynamic time series analytic approach, the effect of development assistance on health status in Ethiopia was examined for the period of 1978-2013. The year 1978 is considered as an initial period for the study as there is a dearth of data for the period prior to that. It also seems reasonable to use 1978 as an initial period since it is also the historical period for the declaration of primary health care (17). The year 2013 was taken as the last period since it is for this period that comprehensive data could be secured.
Life Expectancy at Birth (LEB) is used as a measure of health status as it has long been used in other studies for this purpose (18).

Data sources
Data for the analysis were obtained from World Development Indicators (WDI) (19), Africa Development Indicators (ADI) (20), as well as from Ethiopian Ministry of Finance and Economic Development (21,22) and Central Statistical Agency (23).

Variables
The dependent variable used was Life Expectancy at Birth (LEB). LEB is the average equivalent number of years of full health that a new-born could expect to live, if he or she were to pass through life subject to the age-specific death rates and average age-specific levels of health states for a given period. This indicator is preferred as it is also used as a measure of health status in most other studies used for comparison (6,18). Moreover, it exhibits a stationary pattern after differencing, a basic requirement for time series analysis (24,25).
The independent variables used include:
- Development Assistance for Health Expenditure (DAHE) - refers to health expenditure that originates from external sources. Per capita DAHE in USD was used for the current analysis;
- Public Health expenditure excluding DAHE (PHE⁻DAH): was used as a control variable, and represents recurrent and capital spending from government (central and local) budgets, other than DAHE. A per capita PHE⁻DAH in USD is used. This variable is considered since health expenditures from local sources is among the factors known to influence health status of populations;
- GDP per capita (GDPP) - is gross domestic product divided by mid-year population;
- Total female enrolment in primary education (FEMED) - percentage of the female population of official primary education age. The choice of this variable is by evidence of an earlier finding that when women are educated, they become aware of issues related to health development at household level, such as, nutrition, immunization, health seeking behaviour (26,27);
- FEMED can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition, however, it can provide a valid evidence. The choice was made as this was the only alternative education indicator found for the sampled year; and
- Population ages 15 to 64 (POP) - percentage of the total population in the age group 15 to 64years.

Statistical analysis

Tests for stationarity and long-run equilibrium

Before the exploration of the presence of long-run equilibrium relationship between development assistance for health and life expectancy at birth, two tests were performed to ensure the stationarity of the variables in question. The results of the ADF and Philips-Perron test have guaranteed that the estimated variables are integrated of order one (after first differencing). Furthermore, the presence of long run equilibrium relationship between the two variables in the regression was examined through the multivariate Johansen-Juseliusco-integration test which ascertained the existence of convergence between the long run equilibrium and the short run dynamics of the variables under study.

Furthermore, to examine the effects of development assistance on health outcomes, the vector error correction model was used. The model, besides including time dependency between the variables of interest and allowing for stochastic trends, it uses long-run equilibrium relationships through co-integration. Furthermore, Johansen's approach was used to estimate the co-integrating relations and the other parameters in the model (25,28,29).

Based on previous studies (30,31), the implicit function for our model can be expressed as:

$$Y(t) = f\left(Y(t-1), X_1(t), X_2(t), \dots X_n(t)\right) \quad \dots (1)$$

Where 'n' is the number of explanatory variables.

By taking the derivative of both sides of the equation, the following is obtained:

$$dY(t) = \sum_{j=1}^{n} f_j \, dX_j(t) + f_0 \, dY(t-1) \quad where \quad f_j \ is \ m\arg inal \ effect \ of \ X_j(t) \ on \ Y(t)$$

$f_0 \ is \ m\arg inal \ effect \ of \ Y(t-1) \ on \ Y(t) \ and \ j = 1,2,..n, \ which \ can \ be \ re-written \ as:$

$$dY(t) = \sum_{j=1}^{n} \varphi_j \frac{dX_j(t)}{X_j(t)} + f_0 \, dY(t-1) \quad where \ \varphi_j = f_j \frac{X_j(t)}{Y(t)} Y(t) \ or \ \varphi_j = \varepsilon'_j Y(t) \dots (2)$$

Furthermore, under the assumptions of the constant - φ_j's , one can integrate both sides of the equation, and get:

$$Y(t) = \delta Y(t-1) + \sum_{j=1}^{n} \varphi_j \ln X_j(t) + \alpha_3 \qquad (3)$$

Where - $\delta = f_0$ and α_3 is a constant term.

Having in place the theoretical frame work, the empirical estimation equations for the study can be specified as:

$$LEB = \beta_0 + \beta_{1t} \ln DAHE + \beta_{2t} \ln GDPP + \beta_{3t} PHE^-DAH + \beta_{4t} FEMED + POP + \varepsilon_t \ \dots (4)$$

Where:

- *LEB = Health outcome as measured by life expectancy at birth*
- *DAHE = Development Assistance for Health Expenditure per capita (in current USD)*
- PHE⁻DAH= Public health expenditure other than DAH in per capita (in current USD)
- *GDPP= Gross domestic product per capita (in current USD)*

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- *PREDFem = Total female enrolment in primary education*
- *POP = Population ages 15 to 64*
- *ε_t = Stochastic disturbance term to capture omitted variables*
- *t = 1, 2, 3….36 and βs are the parameters to be estimated.*

To analyze the association between DAHE and LEB, the stationarity of each series was tested using an econometric analysis. The test used for this purpose is the standard Augmented Dickey Fuller (ADF) and Philips-Perron test. This test helps to avoid the spurious results that would make the estimate biased and inconsistent (24,32).

Results

Descriptive results

As shown in table 1, mean (±SD) of LEB and per capita DAHE during the period of the study (1978-2013) were 51(6.44) and 1.73(2.61) respectively. During the same period of study, the range was between 43.67 and 63.62 for LEB and 0.05 and 9.06 for DAHE.

Table 1. Health and the related indicators summary statistics, Ethiopia, 1978-2013

VARIABLES	DEFINITIONS	OBSERVED	MEAN	SD	MIN	MAX
LEB	Life expectancy at birth (years)	36	51.069	6.437	43.674	63.617
DAHE	Development assistance for health expenditure (USD per capita per year	36	1.727	2.612	0.050	9.057
GDPP	Gross domestic product per capita per year	36	218.916	96.336	111.531	502.597
PHE⁻DAH	Public health expenditure other than DAHE	36	1.619	1.660	0.140	6.580
FEMED	Percentage of Female secondary school enrolment ratio (Control variable)	36	46.157	27.585	13.906	100.546
POP	Total Population aged 15 to 64 years (Control variable)	36	3.06E+07	9940617	1.80E+07	5.10E+07

Figure 1 illustrates trends in LEB and DAHE in Ethiopia during the study period of time. The country has experienced a steady increase in LEB, along with a growth (with some variation) in level of development assistance for health.

Figure 1. Trends in life expectancy at birth (LEB) and development assistance for health expenditure (DAHE) in Ethiopia (1978-2013)
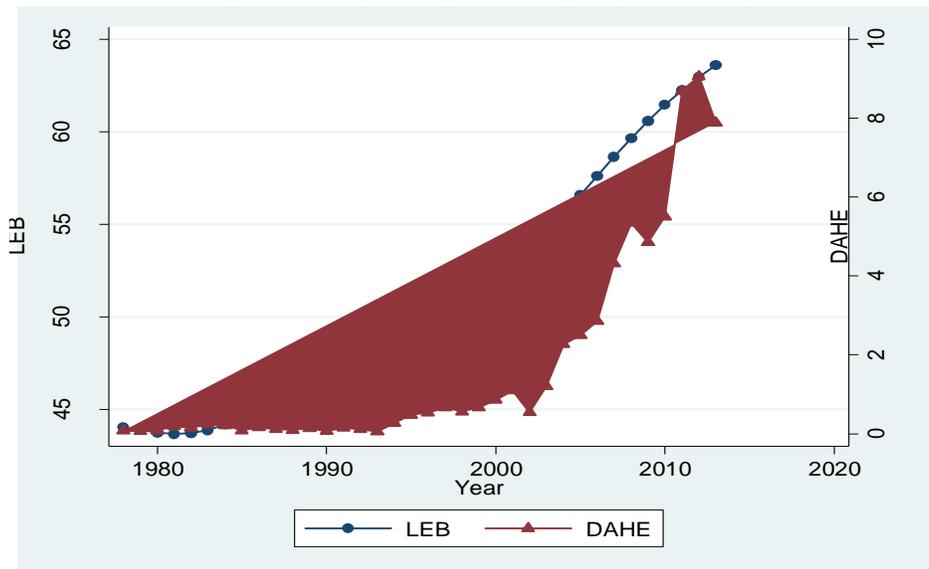
The other way of looking in to this is by plotting a local polynomial smoothing curve that gives a more insight to the change of LEB and DAHE.

Figure 2 below shows that DAHE is increasingly effective in continuously and steadily increasing LEB.

Figure 2. A plot of local polynomial smooth curve of life expectance on development assistance for health per capita (1978-2013)
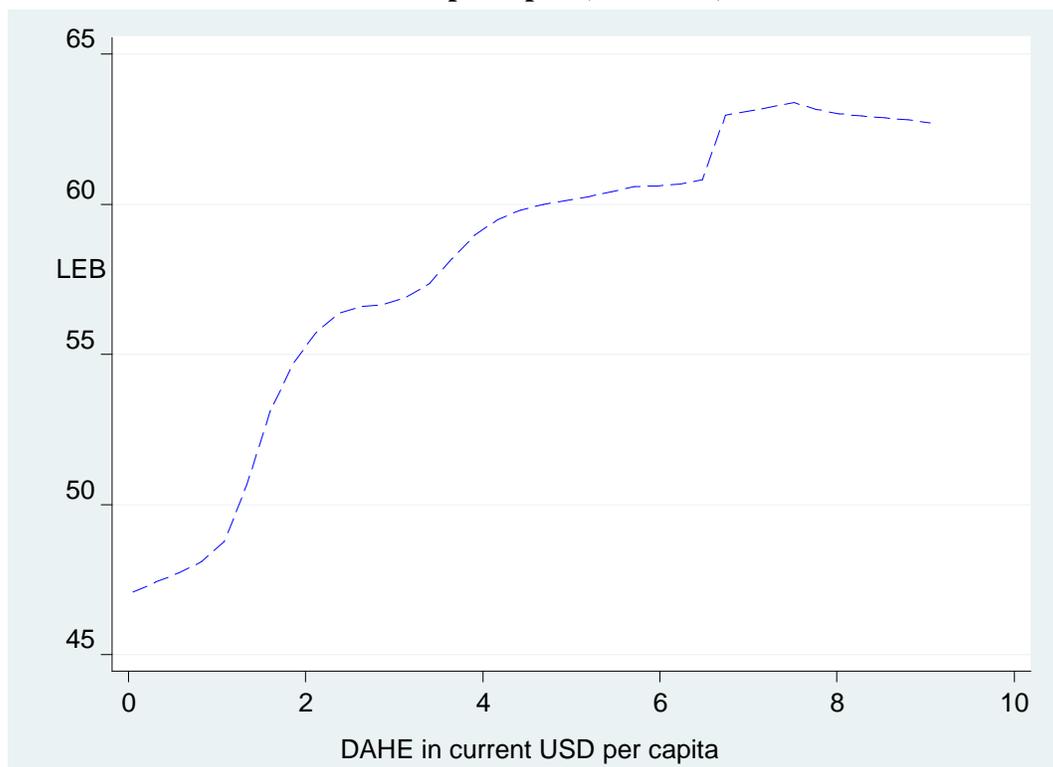
Results from Error Correction Model (ECM)

Once the presence of stationarity and co-integration of the series between the variables in the regression model was established, an error correction model (ECM) was fitted to estimate the relationship between the variables. As can be seen in table 2, the effect of development assistance for health on life expectancy is positive and significant – a 1% increase in development assistance for health leads to an approximate nine days increase in life expectancy (p<0.001). Similarly, the analysis results suggest that there is a statistically significant positive association between level of development assistance for health during previous two periods and life expectance - a 1 % increase in development assistance for health during previous two periods leads to three days increase in life expectancy (p=0.025).

Table 2. ECM estimation results, Ethiopia, 1978-2013

Variables	Coefficient	Standard Error	t-Values	Probability
ECt-1	-0.011	0.001	-9.070	<0.001
LEB LD.	1.822	0.039	46.870	<0.001
LEB L2D.	-1.080	0.052	-20.930	<0.001
lnDAHE LD.	0.026	0.004	6.160	<0.001
lnDAHE L2D.	0.008	0.004	2.240	0.025
lnGDPP LD.	0.083	0.023	3.600	<0.001
lnGDPPL2D.	0.086	0.024	3.620	<0.001
PHE⁻DAH LD.	0.004	0.003	1.390	0.166[†]
PHE⁻DAH L2D.	0.008	0.003	2.480	0.013[†]
PREDF LD.	-0.0004	0.001	-0.770	0.442
PREDF L2D.	-0.0002	0.001	-0.360	0.715
lnPOPD.	2.056	1.279	1.610	0.108[*]
lnPOP2D.	-2.459	0.958	-2.570	0.010[*]
_cons	0.863	0.085	10.200	<0.001

[*]indicates that the Joint effect is insignificant.
[†]indicates that the Joint effect significant.

Public health expenditure other than development assistance during the immediate two previous periods is also positively and significantly associated with life expectancy at birth(p=0.013), indicating a 1% increase in general public health expenditure during the immediate two previous years can lead to three days of improvement in current life expectancy at birth.

The association between GDPP and LEB is also found to be statistically significant (p<0.001) and positive, both during the immediate one and two previous years. A 1% increase in GDPP improves the current level of LEB approximately by 1 month.

Furthermore, the analysis shows that that the relationship between FEMED and LEB is negative but insignificant. The association of population aged 15-64 years and LEB portrays a mixed result. It is positive and insignificant during the immediate previous one year and negative and significant during the immediate previous two periods. However, the joint effect of this variable on LEB is found to be insignificant.

Discussion

The analysis of data under the current study proceeded by testing for stationarity of each series as is common in time series data analysis. All the included variables (LEB, DAHE GDPP, DAHE⁻DAH,FEMED and POP) were undergone the standard Augmented Dickey Fuller (ADF) and Philips-Perron test to avoid the spurious results that would make the estimate biased and inconsistent (24,32).

This study explored the association between life expectancy at birth (LEB) and development assistance for the health sector (DAHE) in Ethiopia using a sample of 36 observations(years: 1978-2013). Accordingly, the effect of DAHE, the variable of interest in this study, is found to have a significant long run influence on the health status of the population in Ethiopia. As the result suggests, the coefficient of ECt-1 has the correct negative sign and is statistically significant (P=0.001) implying that about 1.1% of the disequilibrium in the previous year (year t-1) in LEB are corrected in the current year period.

Likewise, the immediate one and two prior year of DAHE has shown to have a significant positive effect on LEB. Consequently, other things being equal, an increase of DAHE by 1% leads to an improvement in life expectancy at birth by about 0.026 years which is 0.312 month, approximately 10 days (P=0.000). in the immediate year following the period, and 0.008 years or approximately 3 days following the immediate two years period (P=0.025). The short run effect of the result is greater than the findings of Bendavid & Bhattacharya who studied on 140 aid-recipient countries between 1974 and 2010reports change of LEB to DAH as 0.02 month (33). While the period is more or less similar, the applied methodology in their study is panel approach (time series - cross section). Therefore, the observed difference might be an account of methodological difference as this study is country specific, a country with higher inflow of DAH and better performance history in health indicators. Similarly, the result is higher than another cross country study report of LEB elasticity to DAHE in SSA, which is 0.005 year (34). Here again the difference might be an account of better performances in Ethiopia's health care system in utilizing DAH.

As shown earlier, Ethiopia is a country with high inflow of DAH with the expectation of high performance in the health outcome. Therefore, according to the current finding, an increase of DAH has been resulted in an increased life expectancy, even better than that of the average SSA. In Ethiopia, PHC at peripheral level, where most of DAH is changed in to the actual consumers service is widely exercised by innovative programme, a deployment of health extension workers and this might have been an account for the significant effect and difference observed in the current study (35,36). Similarly, the elasticity estimates of the current result is slightly higher than the country specific study conducted in Pakistan (37), that reported 0.024 for the elasticity estimate of LEB with regard to government health expenditure. Again, it seems that the per capita DAHE drives more LEB in Ethiopia than in Pakistan, consonance with the previous stated studies because of the fact that the Pakistan study is total public expenditure.

On the other hand, the current findings contradicts previous conclusions that claim health aid has no effect in developing countries (6,7).

It seems that the effect of the rest of public health expenditure which is in fact domestic funding for health expenditure in the country, has also exhibited more effect in explaining LEB than that of an average SSA do. Holding all others constant, a per capita change in the rest of public health expenditure in the year immediately preceding the period improves LEB by about 0.008 year. This result is higher compared to one cross-country study conducted for SSA, which estimates 0.003 (34).This might be an attribute of the policy commitment in the country to implement

PHC. With regard to the remaining control variables, starting first by considering the GDP, per capita GDP has got a positive significant effect on LEB and this finding is consistent with results reported elsewhere (27,38). This is expected, because as income increases, one would expect the standards of living of the people to improve, meaning that people will have access to better education, health care, housing, etc. reduced mortality and ultimately an increased life expectancy.

In the present study, the relationship between female education and health status showed an unexpected (but not significant) effect, which might be due to possible autocorrelation with the lagged variable for life expectancy.

Finally, the association of population aged 15-64 years and LEB portrays a mixed result. It is positive, insignificant during the immediate previous one year, negative, and significant during the immediate previous two periods. However, the joint effect of this variable on LEB is found to be insignificant. While the positive association is as expected (because this age group is the productive age group that could possibly maximizes health production), the negative sign on LEB during the immediate previous two years might be due to the same age groups' prone to HIV/AIDS that might have led to increased mortality as is a known disease burden in SSA including Ethiopia (37).

In this study, it would have been better had more control variables like environmental sanitation and safe water supplies were considered as these factors are known variables to explain health status in developing countries. However, both variables were not included in the data, because first, there is no adequate data series prior to 1990 for both variables. Second, the available national health account report, a report from where DAHE originates and considered in this study, indicates that health expenditure includes spending on both core and health-related activities such as drinking water and environmental health spending (11). Similarly, consideration of education indicators like net enrolment and school years would have been better but the data are highly deficient for the sampled year.

In addition, health professionals to population ratio and governance are other indicators one would expect to be included. However, all health facility performance related activities is largely an attribute of recurrent and capital health expenditure (39) that is already captured in the study. For instance, hiring health workers and paying their salaries holds the highest proportion of recurrent expenditure, that if considered with health expenditures, lead to a possible higher multi-collinearity among the variables. Governance related variables where other explanatory variables that would have been included at national level. However, the dearth of national data for the sampled period of years has limited the inclusion. Similarly, the proxies used in measuring health outcomes are not exhaustive; especially, morbidity and disability data were not captured. While these limitations may be the bases for future research, the result of the current analysis verified that development assistance for health has favourable effect in improving health status in Ethiopia.

The policy implication of the current findings is that development assistance for health is essential component in improving health status in the country and should continue as an interim necessity means to an end.

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