



**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES**

**Development assistance for health: Trend and effects on health
outcomes in Ethiopia and Sub-Saharan Africa**

**A dissertation submitted to the School of Graduate Studies of Addis Ababa
University in partial fulfillment of the requirements for the Degree of
Doctor of Philosophy (PhD) in Public Health**

BY

Keneni Gutema

Advisor: Damen Haile Mariam (Prof.)

**Addis Ababa University, College of Health Sciences
School of Public Health**

June 2016
Addis Ababa University

DESSERTATION APPROVAL FORM

ADDIS ABABA UNIVERSITY, SCHOOL OF GRADUATE STUDIES

Development assistance for health: Trend and effects on health
outcomes in Ethiopia and Sub- Saharan Africa

BY

Keneni Gutema Negeri

SCHOOL OF PUBLIC HEALTH, ADDIS ABABA UNIVERSITY

APPROVED BY THE EXAMINING BOARD

Chairperson, Examining Board Signature, and date

Supervisor Signature and date

External Examiner

Signature and date

Internal Examiner

Signature and date

Internal Examiner

Signature and date

Dedication

This thesis is dedicated to my incredibly wonderful children Deborah Keneni, Nathan Keneni & Nathanael Keneni (the twin sons) whom I got during the third year of my study period. My beloved kids, I understand that extending the duration of my thesis work to look after you is not a compensation for the love you ought to get from me. I would rather say, “You have made me stronger, better and more determined than I could have ever in completing the long journey, and overcoming the challenges of life throughout this thesis work”.

Original Papers

This thesis is based on the following papers, referred in the text by their Roman numerals:

- I. Negeri KG, Halemariam D. Effect of health development assistance on health status in sub-Saharan Africa. *Risk Management and Healthcare Policy* 2016; (9): 33–42.
- II. Negeri KG, Halemariam D. Does health sector aid matter? Evidence from time series data analysis in Ethiopia (submitted).
- III. Negeri KG, Halemariam D. The effect of health expenditures on health outcomes in Ethiopia: Evidence from time series data analysis (submitted).

Table of contents

Table of contents.....	i
List of Tables	iii
List of Figures	iv
List of acronyms	v
Abstract	vii
1. Introduction.....	1
1.1. Background	1
1.1.1. Historical background.....	1
1.1.2. Contemporary country context.....	6
1.2. Statement of the Problem.....	10
1.3. Significance of the Study	13
2. Literature Review.....	14
3. Objectives and Hypothesis of the Study	22
3.1. General Objective	22
3.2. Specific Objectives	22
3.3. Hypothesis of the Study.....	22
4. Materials and Methods.....	24
4.1. Study Area and Period	24
4.2. Study Type and Design.....	24
4.3. Sample Size.....	24
4.4. Variables and their Description	25
4.4.1. Dependent variables.....	25
4.4.2. Independent variables	26
4.5. Data Analysis	27
4.6. Theoretical Framework.....	28
4.7. Empirical Model Specification	33
4.8. Data Collection Technique and Tools.....	37
4.9. Data Source.....	37
4.10. How the DAHE data were tracked for the study	37
4.11. Data Processing.....	40
4.12. Ethical Considerations	40
4.13. Dissemination of findings	40

5. Results.....	41
5.1. Ethiopia, the Country level study.....	41
5.1.1. Descriptive results.....	41
5.1.2. The Unit root test	44
5.1.3. The co-integration test	45
5.1.4. Result from ECM.....	47
5.1.5. Post-Estimation Diagnostics Test	49
5.2. Sub Saharan Africa: The Regional Level Results.....	50
5.2.1. Descriptive results.....	50
5.2.2. Estimation Results	53
6. Discussion	58
7. Validity and Generalizability	66
8. Strengths and Limitations	67
9. Conclusions.....	68
10. Recommendations.....	70
11. Acknowledgements.....	71
12. References.....	72
13. Appendices.....	81
Appendix I: Detail derivation of Equation 4.....	81
Appendix II: Original Papers	82
Appendix III: List of SSA included in the study	147
13. Declaration page	148

List of Tables

Table 1. Health and the related indicators summary statistics, Ethiopia, (1978-2013).	41
Table 2. ADF unit root test results at level and first difference, Ethiopia, (1978-2013).	45
Table 3. The Co-integration rank results, Ethiopia, (1978-2013).	46
Table 4. The Lag order selection statistics, Ethiopia, (1978-2013).	46
Table 5. The ECM estimation results, Ethiopia (1978-2013).	48
Table 6. The test for normal distribution of residuals.	49
Table 7. Health and the related indicators summary statistics across SSA (1990-2010)	52
Table 8. Estimation results from fixed effect and Random effect, SSA (1995–2010)	53
Table 9. Estimation results from first difference GMM, SSA (1995-2010)	54
Table 10. Health and the related indicators summary statistics, Ethiopia, 1978-2013.	12
Table 11. ADF unit root test results at level and first difference.	15
Table 12. The Co-integration rank results	16
Table 13. The Lag order selection statistics.	16
Table 14. The ECM estimation results, Ethiopia, 1978-2013.	18
Table 15. The test for normal distribution of residuals.	20
Table 16. The test for residual autocorrelation	20

List of Figures

Figure 1. Trends in LEB and DAH in Ethiopia 1978-2013	42
Figure 2. The trend relationship of DAHE and LEB, Ethiopia, 1978-2013.	43
Figure 3. A plot of local polynomial smooth curve of LEB to DAHE, Ethiopia, 1978-2013.	44
Figure 4. Trends in DAHE in Ethiopia, SSA and LAC countries 1995-2013	50
Figure 5. Trends in LEB at birth in Ethiopia, SSA	51
Figure 6. Local polynomial smoothed line for IMR, SSA, 1995-2010	57

List of acronyms

AAU	Addis Ababa University
ADF	Augmented Dickey Fuller Test
ADI	African Development Indicator
AIC	Akaike Information Criterion
ALERT	All Africa Leprosy Rehabilitation and Training Center
CCOR	Control of Corruption
CSA	Central Statistical Authority
DAC	Development Assistance Committee
DAH	Development Assistance for Health
DAHE	Development Assistance for Health Expenditure
ECM	Error Correction Model
EDHS	Ethiopia Demographic and Health Survey
EPHI	Ethiopian Public Health Institute
FEMED	Female Education
FMOH	Federal Ministry of Health
GDPP	GDP per capita
GOEF	Government Effectiveness
GMM	Generalized method of moments
HC	Health Center
HP	Health Post
HIV/AIDS	Human Immunodeficiency Virus /Acquired Immune Deficiency syndrome
HQIC	Human-Quinn Information Criteria
HRH	Human Resource for Health
HSDP	Health Sector Development Program
IHME	Institute for Health Metrics and Evaluation
IHP+	International Health Partnership and Related Initiatives
IMR	Infant Mortality Rate
IMSF	Improved Sanitation Facilities
IRB	Institutional Review Board
LAC	Latin American and Caribbean
LEB	Life Expectancy at Birth
LM	Lag Range Multiplier

LR Likelihood-Ratio
 MDGs Millennium Development Goals
 MMR Maternal Mortality Rate
 MoFEC Ministry of Finance and Development
 NGOs Non Governmental Organizations
 NHA National Health Account
 ODA Official Development Aid
 OECD Organization for Economic Co-operation and Development
 PHC Primary Health Care
 PHE'DAH Public Health Expenditure other than DAHE
 PLAID Project-Level Aid
 RULA Rule of Law
 SBIC Schwarz Bayesian Information Criterion
 SD Standard Deviation
 SDG Sustainable Development Goals
 SIDA Swedish International Development Cooperation Agency
 SSA Sub Saharan Africa
 TB Tuberculosis
 UNDP United Nations Development Program
 UNICEF United Nations Children's Emergency Fund
 USAID United States Agency for International Development
 USD United States Dollar
 VECM Vector Error Correction Model
 WB World Bank
 WDI World Development Indicators
 WHO World Health Organization

Abstract

Background: For decades, health targeted aid in the form of development assistance for health has been an important source of financing health sectors in developing countries. Health sectors in Sub Saharan countries in general and Ethiopia in particular, are even more heavily reliant upon donors. Consequently, a more audible donors support to health sectors was seen during the last four decades, consistent with the donor's response to the global goal of Alma-Ata declaration of “health for all by the year 2000” through primary health care in 1978. Ever since, a massive surge of development assistance for health has followed the out gone of the 2015 United Nations Millennium Declaration Goals in which three out of the eight goals were directly related to health. In spite of the long history of health targeted aid, with an ever increasing volumes, there is an increasing controversy on the extent to which health targeted aid is producing the intended health outcomes in the recipient countries.

Despite the vast empirical literatures considering the effect of foreign development aid on economic growth of the recipient countries, systematic evidence that health sector targeted aid improves health outcomes is relatively scarce. The main contribution of this study is, therefore, to present a comprehensive country level, and cross-country evidences on the effect of development assistance for health on health outcomes.

Objectives: The overall objective of this study was to analyze the effect of development assistance for health on health outcomes in Ethiopia, and in Sub Saharan Africa.

Methods: For the Ethiopian (country level) study, a dynamic time series data analytic approach was employed. A retrospective sample of 36-year observations from 1978 to 2013 was analyzed using an econometric technique - vector error correction model. Beside including time dependency between the variables of interest and allowing for stochastic trends, the model provides valuable information on the existence of long-run and short-run relationships among the variables under study. Furthermore, to estimate the co-integrating relations and the other parameters in the model, the standard procedure of Johansen's approach was used. While development assistance for health expenditure was used as an explanatory variable of interest, life expectancy at birth was used as a dependent variable for the fact that it has long been used with or without mortality measures as health status indicators in the literatures.

In the Sub Saharan Africa (cross-country level) study, a dynamic panel data analytic approach was employed using fixed effect, random effect, and the first difference-generalized method of moments estimators in the period confined to the year 1995-2013 over the cross section of 43 SSA countries. While development assistance for health expenditure was used as an explanatory variable of interest here again, infant mortality rate was used for health status measure done for its advantage over other mortality measures in cross-country studies.

Results: In Ethiopia, the immediate one and two prior year of development assistance for health was shown to have a significant positive effect on life expectancy at birth. Other things being equal, an increase of development assistance for health expenditure per capita by 1% leads to an improvement in life expectancy at birth by about 0.026 years ($P=0.000$) in the immediate year following the period, and 0.008 years following the immediate prior two years period ($P= 0.025$).

Similarly, in Sub-Saharan Africa, development assistance for health was found to have a strong negative effect on the reduction of infant mortality rate. The estimates of the study result indicated that during the covered period of study, in the region, a 1% increase in development assistance for health expenditure, which is far less than 10 cents per capita at the mean level, saves the life of two infants per 1000 live births ($P=0.000$).

Conclusion: Contrary to the views of health aid skeptics, this study indicates strong favorable effect of development assistance for health sector in improving health status of people in Sub Saharan Africa in general and the Ethiopia in particular.

Recommendations: The policy implication of the current findings is that development assistance for health sector should continue as an interim necessity means. However, domestic health financing system should also be sought, as the targeted countries cannot rely upon external resources continuously for improving the health status of the population.

At the same time, the current development assistance stakeholders assumption of targeting facility based primary health care provision should be augmented by a more strong parallel strategy of improving socioeconomic status of the population that promotes sustainable improvement of health status in the targeted countries.

1. Introduction

1.1. Background

1.1.1. Historical background

The beginning of institution based modern health care provision in Ethiopia has a historical link with the external (foreign) assistance to health care provision. For instance, a Russians Red Cross mission in Addis Ababa established the first hospital in the country's history in 1896. Following the establishment of the Russian hospital, three other governmental hospitals were established in the year from 1903-1911. In 1922, an American missionary known as Dr. Thomas Lambie and his co-workers established Gulale Hospital, latter in 1950 changed to "Institute Pasteur"(1) that has been merged with Ethiopian Nutrition Institute and the Department of Traditional medicine of the Ministry of Health, currently named Ethiopian as the Public Health Institute (EPHI)(2, 3). In 1932, Dr. Lambie also built a leprosy hospital in Addis Ababa, now part of All Africa Leprosy Rehabilitation and Training Center (ALERT), later expanded to include tuberculosis (1, 4).

Historically, external assistance to health sector in Ethiopia has also an intense link to the development of Human Resource for Health (HRH). For instance, in 1949, the first School of nursing was established and operated by the Ethiopian Red Cross Society(5-7) under the auspices of the Swedish Red Cross at the then Haile Sellassie I Hospital, presently the Yekatit 12 Hospital (8). In 1951, Princess Tsehai Memorial School of Nursing was established with British assistance in Addis Ababa. In the same year, Nekempte School of Nursing was established by the Swedish Evangelic Mission in the then Wollega Province of the current East Wollega /Oromia (5, 8). During this same period, health assistants (the then dressers) training programs were also established by various mission groups. The training programs were set up primarily to meet nursing service needs of the mission hospitals and clinics within a given geographic area (8), especially in the western and southern rural areas of the country (1, 9).

In 1954, a historically pioneering public health college in the country was established by assistance from World Health Organization(WHO), United Nations Children's Emergency Fund (UNICEF) and the United States Agency for International Development (USAID) in Gondar (5, 10).

During similar period, a number of additional hospitals have been established by assistance from WHO, UNICEF, USAID, and various countries together with technical assistance provided to the then Ministry of Health (MOH) (9).

As the modern health care institutions advanced in the country, the demand for HRH was so critical that in 1960s the Peace Corps, a volunteer program run by the United States government, has been involved in the health assistants, the then dressers training (11). Besides, the direct support of foreign health professional was also remarkable in the 1950s and 1960s. For example, in 1954, out of some 80 physicians in the country, none of them were Ethiopians (5). In 1967, of the 300 doctors practicing in the country, only 10% were Ethiopians, while the rest were foreigners (11).

During similar period of the 1960s, the Dutch, Swedes, Germans, Czechs, Yugoslavs, and Americans have assumed staffing the hospitals in some of the then fourteen provincial capitals of the country. For example, Sweden built and has staffed the Ethio-Swedish Pediatric Hospital and an adjoining (12) Nutritional Research Unit. The then Imperial Central Laboratory has been run by French for years. Certain disease programs were divided and vertically supported by different foreign groups. For example, the Americans have been associated with malaria, the British with leprosy, the World Health Organization with tuberculosis (11).

In response to the pressing need of physicians and other health care professionals observed in 1960s, increasing the health care professional education started with the establishment of the Gondar Public Health College . Consequently, the first medical school was established within Addis Ababa University in 1964 with academic support provided by the British Government (5).

In general, it is well recognized that during the period from the inception of the institute based modern medicine in the late 1890s through 1970s, foreigners (individuals or groups like missionaries), the WHO, UNICEF, United Nations Development Program (UNDP), United States Agency for International Development (USAID), World Bank (WB), Swedish International Development Cooperation Agency (SIDA), and other bilateral and NGOs have stepped in and offered technical and financial assistance in the development and progress of modern health care delivery system in the country. This has long been believed to have helped in expanding access to basic

primary health care services that have been implemented for the prevention and treatment of communicable and emerging diseases such as Malaria and Tuberculosis (TB), epidemics like the eradicated smallpox, maternal and child health care, including immunization services in the country (1,5,9).

While it is very difficult to get the detail information of the aforementioned foreigners support, particularly in monetary terms or in-kind, it is more likely that the contribution is of paramount magnitude to the development of modern health care delivery system in the country.

In the late 1970s, a worldwide action to develop and implement primary health care (PHC), particularly in developing countries, in a spirit of technical cooperation and in keeping with a new international economic order was initiated. In 1978, the Alma-Ata declaration of “Health for all” set a deadline of the year 2000 for achieving a level of health that would enable all of the world’s people to lead a socially and economically productive life. Within this perspective, there was a strong international collaborations from, WHO and UNICEF, as well as other multilateral and bilateral agencies, nongovernmental organizations, funding agencies, supporting the PHC strategies by increased technical and financial support, particularly in developing countries (13).

Thus, besides promoting self-reliance, the Alma Ata declaration of “health for all” has been accompanied by a strong commitment of national and international collaborations through external assistance for health sector, in kind as well as in monetary terms, from bilateral and multilateral institutions (13). As a result, Ethiopia, as a signatory to the Alma-Ata declaration has implemented the Primary Health Care Strategy for decades (5) and has been a recipient country of donor support to implement the PHC.

Another prominent UN initiative, the Millennium Development Goals (MDGs) declaration was introduced in 2000, of which the three goals are directly focused on health: reducing child mortality (goal 4); reducing maternal mortality (goal 5); and combating HIV/AIDS, malaria, and other diseases (goal 6) by 2015 (14).

MDGs emphasize the role of developed countries in aiding developing countries, as outlined in goal 8, which sets objectives and targets for developed countries to achieve a "global partnership for development" by supporting fair trade, debt relief, increasing aid, access to affordable essential medicines and encouraging technology transfer (14). As a result, the international community has substantially increased its aid commitments generally and DAH particularly to assist countries to scale up to meet the MDGs (15). In this aspect, Ethiopia was again a signatory to the summit and subsequently adopted MDGs for implementation and ultimately qualified as being a recipient for more health-targeted aid. Consequently, the absolute amount of external assistance for health, in the form of development assistance for health (DAH) sometimes referred to health aid has been prominent in Ethiopia historically and contemporarily, which is also true in the other developing countries of Sub Saharan Africa (SSA) (16-18).

In spite of the increasing volumes of DAH being directed at improving health care delivery and overall health systems performance in SSA, there is an increasing controversy whether the scaled-up health development aid has strengthened the existing health systems of developing countries and is producing the intended health outcomes (19). Although it has been long believed that health aid improves health outcomes in recipient countries by relaxing resource constraints particularly in low-income countries (20), it has been criticized for years. The critics largely centers on: unpredictability of funding, proliferation of disease and intervention specific programs, which are often not integrated into any particular country's on-going programs, large numbers of new actors and donors, inflexibility of aid for dealing with sudden problems and crises, and lack of accountability of donors for the absence of results and progress (21).

Being one of the main sources of financing health care services in SSA (16, 17,22), DAH has accounted for up to 40.2% of total health expenditure in 2012 in the low income countries of the region. Coinciding with the adoption of the out gone MDGs, and with the substantial focus on maternal, newborn and child health, Human Immunodeficiency Virus infection and Acquired Immune Deficiency Syndrome (HIV/AIDS) epidemics, malaria and tuberculosis infection, the magnitude of aid has reached an all-time high of \$31.3 billion in 2013. This has been more than five times greater than it was in 1990 (23).

As stated earlier, Ethiopia has been one of the major DAH recipient countries for decades with the growing inflows following the country's inception of the Health Sector Development Program (HSDP) by the Federal Ministry of Health (FMOH) (24). For instance, in the years between 2002 and 2007, the country was the second among the 30 countries of the world that received the greatest cumulative DAH following India (17). Similarly, in the years between 2009 and 2011, Ethiopia received the second highest volume of average DAH among the 24 low and lower-middle income countries, while in 2011 alone, the country received the most health aid of all DAH recipient countries (23). Correspondingly, the National Health Account (NHA) of Ethiopia shows that in the country, DAH from donors and international Non-Governmental Organizations (NGOs) covers 50% of general health care spending in the year 2010/2011, up from 40% in the year 2007/2008, though the figure was not adjusted for population (18).

Considering changes in the health status of the country, evidences show that there is a progressive improvement in the health outcomes during the last three decades. Under-five mortality rate is reduced by two thirds between 1990 and 2015 and the country has achieved MDG 4 (reduction of child mortality) two years before the target year (25, 26). The results of the Ethiopia Demographic and Health Survey (EDHS) for the years 2000, 2005, and 2011 also document a continuous declining trend in under-five and infant mortality rates. Under-five mortality decreased by 47 percent, from 166 deaths per 1,000 live births in the year 2000 to 88 in the year 2011, while infant mortality decreased by 39 percent, from 97 deaths per 1,000 live births in the year 2000 to 59 in the year 2011 (27-29).

Neonatal mortality rate decreased from 49 deaths per 1,000 live births in the year 2000 to 39 deaths per 1,000 live births in the year 2005 and it has remained stable at 37 deaths per 1,000, as reported in the 2011 EDHS. Similarly, there is no evidence to suggest that the maternal mortality ratios (MMR) decreased in the country between 2005 and 2011. According to the same sources, the estimated MMR is 676 in the 2011 EDHS and it was 673 in the 2005 EDHS (27-29). Evidence also indicates that the proportion of births attended by a skilled health personnel in Ethiopia was low ($< 20\%$) in the year 2011 (25).

Whether the aforementioned changes in the health outcomes are partly attributed to the increased inflow of DAH in the country is the focus of this study. While it is expected that an increase in DAH

will improve health outcomes, across the world, there is no consensus as to whether DAH improves health outcomes in the recipient country.

Some researchers argue that health specific aid leads to improved health outcomes in developing countries by relaxing resource constraints that directly improve health service delivery (20, 30-32). On the contrary, others claim that there is no as such reliable empirical evidence supporting the claimed positive effect of health aid on health outcome, arguing that funds going to the health sector basically have no impact on the level of health status indicators across countries (33-35). In this regard, for example, Williamson reports a negligible impact of health sector aid on a variety of health outcomes, including Life Expectancy at Birth (LEB) and Infant Mortality Rate (IMR) (33). Similarly, Kosack and Tobin also find no impact of development assistance on infant mortality or life expectancy (34). Likewise, Wilson, using data containing DAH of 96 high mortality countries, shows no effect of DAH on mortality (35).

Owing to scarcity of studies on the effect of DAH on health status in low-income countries in general, and country specific literatures in particular, this study attempts to analyze the effect of DAH on health outcome in Ethiopia, and in SSA. The primary contribution of this paper is, therefore, to present country specific and region based evidence of DAH effect on health status.

1.1.2. Contemporary country context

Ethiopia is the second-most populous country in Sub-Saharan Africa with a population of 97.0 million, and population growth rate of 2.5% in 2014 (36).

The country is a land-locked country, sharing borders with six countries: In the north, Eritrea and Sudan, in the east, Djibouti and Somalia, in the south Kenya and in the west South Sudan. Ethiopia has different climate zones, varying according to longitude and latitude. Climate variations such as rainfall and higher-than-average minimum temperature have created uncertainty in the occurrence of certain diseases like malaria. Majority of the population (83.6%) are rural dwellers, making Ethiopia one of the least urbanized countries in the world (37, 38).

Currently, Ethiopia consists of nine self-governing regional states (Afar, Amhara, Benshangul-Gumuz, Gambella, Harari, Oromia, Somali, Southern Nations Nationalities and People, Tigray) and two city administrations (Addis Ababa and Dire Dawa)(38).

Health status

Ethiopia is characterized by a predominantly rural and impoverished population with limited access to safe water, housing, sanitation, food and health care(37). The estimated LEB was 65 in 2013, and the country's under-five, infant and neonatal mortality rates were 68, 44 and 28 per 1000 live births respectively in 2013 (37-39)). Ethiopia has high maternal mortality ratio, with an estimated 420 maternal deaths per 100 000 live births (40).

Although the achievement observed in the reduction of under-five mortality rates is noticeable, about 190,000 children are still dying each year. Moreover, the reduction in neonatal mortality rate is slow. There is also a high mortality and disease burden from nutrition-related factors among children under the age of 5 years. A total of 25.2% of children are underweight, while 40.4% are stunted (38).

The prevalence rate of HIV/AIDS was 2.4%, and there were 1.1 million people living with HIV. The HIV prevalence rate exhibits a marked variation between urban and rural populations at 7.7% and 0.9%, respectively (37).

Nearly three quarters of Ethiopia is considered to be malaria prone. Annual average malaria cases reached 3 million during the year 2000 to 2005; however, the number of cases is declining as of the year 2009. The lower levels of malaria mortality after 2004 are associated with an expansion of the malaria control program (37).

Ethiopia ranks third in Africa and eighth out of the 22 highest TB burdened countries in the world. The prevalence of all forms of TB is estimated at 527 per 100 000 population, leading to a 64 per 100,000 population mortality rate annually. The incidence rate of all forms of TB is estimated at 359 per 100,000 population, while the incidence rate of smear-positive TB is estimated at 163 per 100,000 (37).

Health system outcomes

The national health policy of Ethiopia emphasizes core principles of democratization and decentralization of the health system of the country. The health sector follows a 5-year rolling plan as part of the national development plan and since 1997–1998, four consecutive phases have been implemented. Health facility expansion has been given a priority by the government, especially those of primary health care(38).

The Ethiopian health service has been restructured into a three tier system; primary, secondary and tertiary level of care. The primary level of care includes primary hospital and the Primary Health Care Unit (PHCU) - which is composed of a health center (HC) and five satellite health posts (HPs). These are expected to provide services to approximately 25,000 people altogether. A HC is expected to be staffed with an average of 20 staff to provide both preventive and curative services. A primary hospital provides inpatient and ambulatory services and expected to provide services to an average population of 100,000. In addition to what a HC can provide, a primary hospital is expected to provide emergency surgical services, including cesarean sections and serves as a referral center for HCs under its catchment areas, with the expected inpatient capacity of 25-50 beds, staffed by an average number of 53 persons(38).

A general hospital provides inpatient and ambulatory services to an average of 1,000,000 people and is expected to be staffed by an average of 234 professionals. It serves as a referral center for primary hospitals. It serves as a training center for health officers, nurses and emergency surgeons. A specialized hospital is expected to serve an average of five million people and expected to be staffed by an average of 440 professionals and serves as a referral for general hospitals(38).

Despite the improvements made in expanding access to health services, the disease burden is still high and the service utilization rate remains low, partly due to the burden of high out-of-pocket spending that restricts an already poor society from health care utilization. The government has initiated plans and pilot schemes to implement community-based health insurance and social health insurance to address financial barriers to accessing health services. Although the majority of maternal deaths could be prevented through appropriate reproductive health services before, during and after pregnancy, only one fifth of all deliveries are currently attended by a skilled health professional (37).

Partnerships for health development

The national health policy of Ethiopia emphasizes that solving the multifaceted problems of the health sector requires timely collaboration of the government with the private sector, nongovernmental organizations, multilateral and bilateral development partners, and other sectors and the public at large. In this view, the government has devised strategies to collaborate with development partners, nongovernmental organizations and various ministries to improve the health status of its citizens, among which the governance structure of the fourth HSDP was revised to better coordinate development partners with the government and other stakeholders within the health sector (37,38).

Over the years, the health sector has made major strides in mobilizing the resources coming into the country from different donors. Although this is encouraging, the numerous plans, budget channels and reporting requirements by donors are recognized to have caused serious burden to Ethiopia's already weak health system and capacity. To combat this problem, the government has embarked on a journey following the global agenda on harmonization and alignment as set out in the Paris Declaration. This was reflected at country level when Ethiopia became a signatory of the Global International Health Partnership and Related Initiatives (IHP+) and was the first country to develop and sign a country-based IHP+ Compact (37,38). Thus, regardless of the shortcomings, three channels have been in place to disburse such partnership funds in the country; via MoFEC, Sector bodies (FMOH and regional health bureaus in this case) and via the donors directly (24).

1.2. Statement of the Problem

As noted earlier, national and global public health measures that increased DAH have been implemented all around the globe, and country-level mortality has fallen significantly in recent decades in all, but a few countries. Are the two linked? Does DAH improve recipient countries' health status?

There is an ongoing debate among the scholars about the effectiveness of aggregate aid to developing countries, which is seemingly unresolved. Even though the focus in this debate has been the effectiveness of aid concerning economic growth, there have also been inconclusive discussions on the effect of health aid on health status of the recipient countries.

In this context, it might be logical to see a portion of evidences that illuminates the existing dilemma. According to the World Bank data (41, 42), in 1978, during global declaration of Alma Ata 'health for all by the year 2000' a representative newly born baby in Ethiopia, and average SSA country expects to live 46 and 49 years respectively. Whereas, a baby born in a high income OECD economies expects to live 76 years, which is 30 and 27 years more than that of Ethiopia and SSA respectively, a close to one generation time. In simple terms, a child born in OECD economies has the opportunity of gaining social knowledge from her/his grandparent's generation, whereas a child born in an average SSA has no such opportunity.

After 20 years of implementation of PHC, in 1999, this indicator was 52, 51 and 81 for Ethiopia, SSA and high-income OECD countries respectively, a gap of 29 and 30 years between that of Ethiopia, SSA and high-income OECD countries respectively.

After a decade of MDGs implementation, in 2013, the same indicator for Ethiopia, SSA and high income OECD was 65, 58 and 83 a gap of 18 and 25 years with that of Ethiopia, SSA and high-income OECD countries (39, 41, 42). While the period from 2000 – 2013 is the high time of MDGs implementation period with a remarkable contribution of donors, the tendency of narrowing the gap between the developing SSA and high income countries is slow, but seems remarkable in Ethiopia.

What is it that made health status in SSA's so different from that of OECD? Is the factor underlying such a disturbing case something unalterable given or something that can be altered?

Even in consideration with additional comparable indicator and region, similar picture can be seen. According to the same statistical source above (41), during 1978s the life of 144 and 122 per 1000 live births passed before they celebrate their first birthday in Ethiopia and SSA respectively. During the same period, Latin America and the Caribbean (LAC) region have managed to reduce IMR down to 74, and high-income OECD countries reduced further to 16. After 20 years journey, with the global goal of "health for all by 2000 " in 1999, Ethiopia and the SSA region were able to reduce the rate to only 93 and 97 infants per 1000 live births and this indicator was 30 and 6 for LAC and OECD respectively. Observing the changes in IMR further, during the MDGs era, in 2013 it was 45, 60 and 17 for Ethiopia, SSA and LAC respectively, while it was 4 for high income OECD countries (39, 41, 42) .

Two opposing arguments could be raised from these figures: encouraging and disappointing facts. A promising, progressive health improvement has happened during the last three decades at different degree of change in SSA, notably in Ethiopia. The figure also points to the existence of inability to save the life of tens of thousands of infants in an average SSAs that was not beyond human capacity, even if it was beyond the SSA's, despite multitudes of factors related to people's living conditions that might have formed such a disturbing condition of life. Nevertheless, the gap between SSA and LAC has a more pronouncing message to why SSAs progress is so slow irrespective of high inflow of DAH in the region.

What can be said about such differences among different regions of the world? Is there something that individuals in SSA countries can do to eliminate this striking difference between their region and other part of the world? If so what is it exactly? Is there something that governments of SSA can do to alter the existing situation, which fall beyond individual's capacity? Is there some role that the well-performing international community can do that fall beyond the capacity of the regions' governments? If yes, what is it? Should it be limited to sharing their knowledge resources or should it include more sharing part of their financial and in kind resources as well? If it includes sharing of financial and in kind resources, as is conventionally accepted and being implemented, how is its

effect on the health outcome of the recipient SSA countries? Does such in kind and financial contributions matter?

Leaving much of these and a number of similar questions open, this study concentrates on investigating the country specific effect of development assistance for health in Ethiopia and in SSA.

Regardless of major challenges related to aid effectiveness including fragmentation, unpredictability, fungibility and harmonization as detailed in literature review of the next section, a number of researchers hold the view that external financial and in kind assistance to developing countries is one of the possible mechanisms by which the aforementioned progress in health status was achieved and without such support the health status of the recipient nations might have been worsen. However, this view is quite debatable as some others disagree with the view and hold the belief that health status improvement comes only from within. This controversy forms a dilemma to policy makers as to whether to treat the external health assistance to health as a complementary tool or just disregard it.

To worsen the matter, country specific and region specific cross-country empirical studies made on this subject are scanty. This is surprising, given the global attention devoted to prevent disease and promote health in developing countries for decades with massive push of DAH in kind and in monetary terms during the implementation period of Alma Ata "health for all" by the year 2000(from 1978-2000) and MDGs by 2015.

Furthermore, while the question of the effect of donor support for health sector needs to be answered using the actual health expenditure data originating from external sources (distinct from commitments and disbursements), the existing few literatures consider either commitment or disbursement data. However, both cases do not necessarily indicate the actual amount of aid expenditure that the recipient country used for health care provision. In this regard, Maellie *et al* strongly argued, neither commitments nor disbursements reflect the actual financial resources arriving in a recipient country for its use in improving health. The authors states that commitments include a substantial component of health aid that is never intended to be used in the recipient country and disbursements almost always reported by donors also include funding that remains in the donor

country to cover expenses related to development assistance, such as the health costs of foreign students (43).

In this context, so far, evidences of the effect of DAH expenditure on health status are nonexistent. In particular, macro level country specific studies on the effect of DAH on health outcome in Ethiopia, and even regionally, that consider the actual DAH expenditure are scanty.

1.3. Significance of the Study

Development assistance for health has been an important part of financing health sectors in developing countries like Ethiopia for decades. In the SSA region, the health sector is particularly heavily reliant upon donor funding. The more rapidly increasing trend in DAH in the last three decades, starting in the late 1970s, is consistent with the donor response to the “health for all” by the year 2000, MDGs implementation of 2000-2015 as well as the HIV/AIDS pandemic. Currently, similar trend in DAH is expected to continue, given that among the incoming SDGs is ensuring healthy lives and promoting well-being for all at all ages (44).

In this perspective, evidence based information on the effect of DAH is crucial for national and international policy makers, bilateral organizations, multilateral organizations and other development agencies, health system managers and planners to make intelligent choices and decisions.

As a one response to this situation, this study aims to present new, systematic and comprehensive evidence that will be a valuable input to the ongoing debate on the effect of DAH on health outcomes in developing countries of the world -in a way that can be of assistance for health planning and policy development at national and regional level.

2. Literature Review

The beginning of modern development aid is rooted in the context of Post-World War II and the Cold War launched as a large-scale aid program by the United States in 1948, known by the European Recovery Program, or Marshall Plan(45). During the early 1950s after independence, developed countries had assisted newly independent developing countries through multilateral and bilateral aid programs in order to support reconstruction and rehabilitation known by Official Development AID (ODA). However, there is an ongoing debate about the effectiveness of such aid in developing world, which is seemingly unresolved so far. In this regard, it is worthwhile to have a close look at the argument of Jeffrey Sachs, William Easterly and Dambisa Moyo, economists with a wide array of views towards aid and its outcomes in developing countries (46-51).

Arguing on the importance of aid to developing countries, Sachs broadly asserts the existence of “poverty traps”; a cyclical chains of events that keep countries in poverty. He argues that, a large number of countries with the extreme poor are caught in a poverty trap, are trapped by disease, physical isolation, climate stress, environmental degradation, and by extreme poverty itself and unable on their own to escape from extreme material deprivation. Even though life saving solutions exist to increase their chances for survival, these families and their governments simply lack the financial means to make these crucial investments leading them to fail in a vicious circle of poverty. Thus, Sachs believes that it is essential to break this poverty trap so that the poorest countries can get rid of poverty. To break these poverty traps, he prescribes what he calls the big push where the cyclicity of the trap is discontinued by one generation lifted out of poverty. Hence, the next generation will not grow up in extreme poverty. Sachs suggests that this can be done only by intensifying aid to countries that are in a worst poverty traps. According to Sachs, doubling total aid, debt relief and increasing use of malaria bed net is a solution for overcoming extreme poverty. Being a strong proponent of developmental aid, Sachs claims that measles was brought down by 91% since the year 2000 across Sub-Saharan Africa and that this is attributable to aid activities (46, 47).

Easterly, as a critical response to Sach’s argument, criticizes the modern look on aid to Africa, voicing the view that aid is a poor instrument in relieving poverty. He asserted that poorest countries in 1950 did not remain stacked in poverty over the next half century. The poorest fifth of countries in

1950 increased their income over the next five decades by a factor of 2.25. The other four fifths increased their incomes by a factor of 2.47. On the case of countries who remain extremely poor, claimed to be stacked in poverty trap, he pose a question “If it’s so easy to end the poverty trap, why haven’t the Planners already made it history”? Moreover, Easterly argues that aid giving world sees themselves as the mighty savior for the extremely poor countries. The “it is up to us” mentality of these donors is a paternalistic view. The general issue being, that the west are forcing the developing countries to change into something that the west believes to be the best way to go. This is a destructive way of development to any country, according to Easterly. Though Easterly is skeptical towards many of the trends that are common in the field of foreign aid, arguing foreign aid to many third world countries has failed to produce sustainable growth, his suggestion is not to withdraw aid to the poorest in the world, but rather make sure it reaches their hands. Despite his overall skepticism of the effectiveness of foreign aid in general, Easterly also posits that perhaps “aid even works on average in some sectors, such as health, education, and water and sanitation (48-50).

The Zambian economist, Dambisa Moyo places herself on the opposite side of the spectrum compared to Sachs when it comes to aid efficiency. She argues that foreign aid has harmed Africa and should be phased out. To back up her arguments, Moyo claims that over 1 trillion USD has been given in aid to Africa over the past 50 years and that this has had a negative impact on African growth and claims that Africa is poorer now than it was two decades ago. Moyo argues, despite the fact that African countries have received more than US\$300 billion in development assistance since 1970, majority of sub-Saharan countries flounder in a seemingly never-ending cycle of corruption, disease, poverty, and aid-dependency. She argues that African countries are poor precisely because of all that aid. Despite the Widespread Western belief that the rich should help the poor, and the form of this help should be aid, according to Moyo, the reality is that aid has helped make the poor poorer, and growth slower. In Moyo's startling words, aid has been, and continues to be, an unmitigated political, economic, and humanitarian disaster for most parts of the developing world. She claims, it is the “disease of which it pretends to be the cure.” According to Moyo, over the past thirty years, the most aid-dependent countries have exhibited an average annual growth rate of minus 0.2 per cent. When aid flows to Africa were at their peak, between 1970 and 1998, the poverty rate in Africa actually rose from 11 per cent to a staggering 66 per cent.(51).

While the debate on the effectiveness of an aggregate aid is such an obvious issue, the existence of resources shortage and the need to improve health in low-income countries has been extensively participated international community in financing health sector of the developing countries particularly SSA.

Globally, developing countries of the world in general, and SSA in particular, bear the highest burden of disease with high rate of population growth. Inversely, health spending in these countries is very low, and even lowest in SSA compared to the rest, in which Ethiopia is not an exception. While the majority of health problems in these countries are preventable, the health systems are in resource scarce settings, and in many cases, unable to provide services that could prevent adverse outcomes(23). In response to this, multilateral and bilateral organizations, NGOs, and private initiatives have been participating for decades in supporting developing countries of SSA to improve the health status of their population. As a result, there has been massive flow of financial and in-kind resources from global communities to the health sectors of these regions to support health interventions. The national and international campaign under the auspices of three prominent global declarations is a witness for the massive flow of DAH from international communities to developing countries in general and SSA in particular(13-15, 44).

The Alma-Ata declaration of “health for all” by the year 2000 through Primary Health Care (PHC) urged national and international action to develop and implement primary health care worldwide and particularly in developing countries in a spirit of technical cooperation and in keeping with a new international economic Order. The declaration set a deadline of the year 2000 for achieving a level of health that would enable all of the world’s people to lead a socially and economically productive life(13). At the same time it urged national governments, WHO and UNICEF, and other multilateral and bilateral agencies, nongovernmental organizations, funding agencies, all health workers and the whole world community to support national and international commitment to primary health care and to channel increased technical and financial support to it, particularly in developing countries (13) .

Following the earlier declaration of Alma-Ata “health for all” in 1978, the prominent UN initiative MDGs was introduced in 2000 of which three of the eight goals(reducing child mortality (goal 4),reducing maternal mortality (goal 5), and combating HIV/AIDS, malaria, and other diseases (goal

6) are directly focused on health. MDGs emphasize the role of developed countries in aiding developing countries, as outlined in goal 8, which sets objectives and targets for developed countries to achieve a "global partnership for development" by supporting fair trade, debt relief, increasing aid, access to affordable essential medicines and encouraging technology transfer(14). As a result, the international community has substantially increased its aid commitments generally and DAH specifically to assist countries to scale up to meet the MDGs (15).

Currently, attainment of healthy lives for all by 2030 is among the key target of Sustainable Development Goals (SDGs), an intergovernmental set of aspiration goals for the post-2015 development(44).

It has generally been argued that the previous two international declarations and the incoming SDGs are accompanied by a high-level national and global participation for the improvements in the health status of developing countries. While there are skeptics, others argue that without DAH the health of the targeted countries might have been deteriorated, and that there is a need for more global collaboration and contribution for the betterment of health in these countries now and then (15).

As a result, multiple multilateral, bilateral, NGOs and private initiatives have made significant contributions both financially and in kind during the implementation period of the above declarations. Given the massive global hand-outs that existed for decades, evidence of the existence of changes of health status in relation to the given health aid, and if so, the extent to which the changes in the health status of the recipient countries can be attributed to such contributions have been points of debate within the literature (16, 17, 23).

In SSA, the health sector is particularly heavily reliant upon donor funding. The more rapidly increasing trend in DAH in the last two decades, starting in the late 1990s, is consistent with the donor response to MDGs as well as the HIV/AIDS pandemic. While the volume of financial resources for the health sector has reached unprecedented levels and continues to rise, significant bottlenecks to efficiency, effectiveness, and high quality service provision remain, and health outcomes in many countries are stubbornly poor(20, 52).

There is considerable variation across countries in the contribution of the external assistance as a share of total health expenditures. For example, during the period from 2000 to 2005, external assistance accounted for 25 percent or more of total health expenditures in 17 recipient countries. In 11(65%) of these 17 countries, external assistance accounts for more than 35 percent of total health expenditures (52). While it has been a long belief that DAH relaxes the shrinking resources of health care services in recipient nations (20), the high dependence on donor aid for financing the health sector raises several concerns, predominantly in SSA, where the share of DAH allocated has increased steadily (53).

At the same time, SSA are often used as an example to suggest that aid is ineffective, on the grounds that African people remain among the poorest in the world despite having been major recipients of foreign aid for several decades (54). In this aspect, key challenges in the provision of more effective DAH are well explained in the literature (15, 52, 55,56).

First, aid can be unpredictable, short-term and volatile. The volatility of aid flows over time challenges countries' ability to plan for the long-term. When the amount of aid a country receives is likely to change at short notice, it is impossible for ministries of health and finance to make long-term plans – such as employing additional critical staffs like doctors, widening access to preventive and curative care or scaling up health service provision – without incurring major risks around sustainability of financing for these services. Aid turned on and off may contribute to drug resistance as medicines are provided and then withdrawn. A related issue, which also creates difficulties for ministries of finance and planning, is that aid can be unpredictable (disbursements do not match commitments), this may occur for reasons unrelated to performance. While volatility is an issue in all aid-dependent sectors, the issue is particularly acute in health because of the high proportion of long-term recurrent costs in health budgets and the importance of external aid as a health-financing source in heavily aid-dependent countries like SSA (15, 52, 55, 56).

Second, diversion of funds to public expenditures other than those for which the aid is intended, commonly known as fungibility. Essentially, aid, once received, may displace other domestic resources, which in turn are then used for other priorities. Because of the fungibility of donor assistance, donor funding may not actually be additional to domestic spending, or at least to the

extent that donors intend. When priorities do not match, governments can reduce their domestic revenue-based support for programs they perceive to be well funded by donors. In other words, if there is strong external support for health, governments may feel they do not need to allocate their own resources to the sector. Fungibility may not necessarily be awful – governments may decide to allocate the funds released by donor funding to locally important priorities that have been historically underfunded. However, the volatility of aid increases the potential that resource allocation is not optimal. For example, if donors stop or decrease funding levels in a country where the government diverted funding to another area upon the receipt of donor funding, the government may be hard-pressed to quickly re-allocate resources to finance the gap left by the decrease in donor funding. Studies show that in Africa, governments do not spend all sectorial aid in the targeted sector, and that the fungibility of donor aid is related to the number of donors active in the country and the relative importance of donor aid in government expenditures (52,53,55).

Third, Harmonization of donor activity, the large influx of external financing could strain the recipient country. Hence, there has been increased focus among the donor community to harmonize and align external assistance efforts and reduce the monitoring, evaluation, and reporting burden placed on countries (52,53).

Fourth, the acceptance of external financing comes with a certain level of involvement of the donor in the setting and implementation of policy. Ministries of health may over-rely on technical assistance provided by the donor in key departments such as planning. Such reliance can compromise consistency in policy priorities over the long term, as changes in donor project cycles are often accompanied by shifts in perspectives on key issues (52,53).

Fifth, with massive inflows of aid, there are concerns about “Dutch disease,” i.e., the appreciation of a country’s currency and the decline in its worldwide competitiveness following the receipt of large aid inflows into specific sectors. While typically applied to natural resources, the concept is relevant to development in any sector receiving large increases in foreign aid flows (52,53).

Capacity of many governments in sub-Saharan Africa to absorb large influxes of donor funds is limited. As a result, some countries in sub-Saharan Africa have had difficulty using funds received from donors (52,53).

Fragmentation of donors is another challenge observed, notably in Ethiopia, a country with large number of operating donors. It was argued that fragmentation in the country can be manifested in the form of number of donors, financial size of each donor and number of activities funded by the donors (24).

Despite the ample empirical research results we have in the literature, considering the effect of foreign aid on economic growth, there is paucity of researches dealing with the effects of aid in the form of DAH on health outcomes.

Within the available part of the literature itself, there is lack of agreement concerning effect of health aid in developing countries. Some writers argue that health specific aid leads to improved health outcomes in developing countries by relaxing resource constraints and directly improving health service delivery. In line of this thought, Levine argues that health is an area where development assistance is likely to see positive changes because health activities such as prevention and control of communicable diseases through safe and adequate water supply, effective sanitation, immunizations, and better nutrition are directly related to the sought health outcomes(57). Ebeke, and Drabo(30), and Mishra and Newhouse(20) also report a strong positive effect of health aid on health outcome in developing countries. Using donor commitments aid data from 118 recipient countries between 1973 and 2004 period, Mishra and Newhouse found that health aid has significant beneficial effect on IMR(20). Chauvet, Gubert and Mesplewho analyzed the respective impact of aid and remittances on infant and child mortality rates with a panel data of 109 developing countries from 1987 to 2004, also reported results that suggest health aid significantly improves health outcomes. However, these authors underlined the fact that the impact of health aid is non-linear that implies aid to the health sector is more effective in the poorest countries (31). Similarly, Gormanee, Girma and Morrissey who used quintile regression analysis, find that aggregate aid improves health status of developing countries. They also pointed out that at a lower income levels, the benefits of aid to human welfare are higher (32).

On the contrary, other writers argue that there is no as such reliable empirical evidence supporting the claimed positive effect of health aid on health outcomes. Williamson, for example, looked into the impact of foreign aid commitments by donor to health sector using a panel set of 208 countries of developed and developing world data from 1973 to 2004, and found no significant impact of health sector aid on a variety of health outcomes (33).

Similarly, Wilson, using panel data of 96 countries with high mortality during 1975-2005 periods, tests the relationship between DAH and a recipient country's infant mortality rate. His empirical analysis suggests that DAH has no effect on mortality at the country level(35).

Although SSA in general and Ethiopia in particular are the biggest recipient of DAH (17), evidence on the relationship between DAH and health status outcome in the region is scanty. The few available studies make use of a full sample of developing countries, though controlled for the region using regional dummies. Besides, most of the previous studies make use of DAH data on commitments (20, 30,33) that may not necessarily be the actual amount of aid that the recipient country utilized for health. To get a more refined result concerning the effect under consideration in the region, one needs to investigate the case of the region separately using development assistance for health expenditure data instead of health aid commitment or disbursement data.

3. Objectives and Hypothesis of the Study

3.1. General Objective

The overall objective of the study was to analyze the effect of development assistance for health on health outcomes in Sub Saharan Africa with focus on Ethiopia

3.2. Specific Objectives

The specific objectives of the current study were:

1. To describe patterns and document historical development of development assistance to health sector in Ethiopia;
2. To determine the effect of development assistance for health on health outcomes in Ethiopia;
3. To analyze the effect of development assistance for health on health outcomes in sub-Saharan Africa.

3.3. Hypothesis of the Study

The overall goal of DAH is to improve health in recipient country population, whether indirectly with budget assistance for government or directly through projects on the ground.

Thus, if DAH can be associated with improvements of health outcomes in Ethiopia specifically, and SSA in general, it can be considered effective. Numerous pathways by which DAH can lead to increased health outcomes could exist. For example, building health infrastructure and training health personnel results in better quality and increased accessibility of health care. By increasing the number of trained health personnel and providing more hospitals, health centers and health posts with better supplies, DAH allows more people to receive better medical care, thus extending life expectancy and decreasing mortality rates. Additionally, immunizations, distribution of malaria bed nets and other prevention, treatment and control programs targeting maternal and child health care, diarrhea, TB and HIV/AIDS, nutritional programs, and essential medicine distribution reduce susceptibility to diseases, thereby resulting in a healthier population.

Therefore, this study hypothesized that DAH will have significant positive effects on life expectancy and negative effects on infant mortality.

4. Materials and Methods

4.1. Study Area and Period

Ethiopia (country level) and SSA countries (regional level) were the geographical areas considered for the study. In this regard, the period from the year 1978 to 2013 was considered for the Ethiopia country level study and the period from the year 1995-2013 was included for SSA. The included SSA countries are listed in Appendix III.

4.2. Study Type and Design

As noted above, this study was intended to analyze country level and regional level data. Therefore, for the country level study, a dynamic time series data analysis was employed using an econometric technique - a vector error correction model (VECM). Beside including time dependency between the variables of interest and allowing for stochastic trends, this model provides valuable information on the existence of long run and short run relationships among the variables under study(58).

For the SSA study, a dynamic panel data analytic (time series - cross sectional) approach is employed, for its advantages over pure time series and pure cross sectional approaches. In this approach, the study is confined to the period from the year 1995-2013 over a cross-section of 43 SSA countries.

Details of the chosen models are explained under the theoretical framework and empirical model specification section.

4.3. Sample Size

For the country level study, a time period from the year 1978 to 2013 and a total of 36 years observations were included purposively, based on the availability of comprehensive and complete data for the study variables and as more than 30 time-series points are also reasonable(59). At the same time, the initial year 1978 was chosen for the fact that it is a historically base year during which the global goal of “health for all by the year 2000” using PHC as a strategy has been initiated. As a result, an immense donor's contribution has followed the initiation of PHC strategy in developing countries.

This study considered the year 2013 as the last study period because it was for this period that last recent and comprehensive data was found from the commonly tracked DAH data sources during data collection, even though the year 2013 is two years short of the end of MDGs implementation (2015). Overall, the time-period 2000-2013 enables to reasonably capture the surge in DAH since the enactment of the MDGs that allows better opportunity to examine the effect of the DAH outpouring in the country.

For the SSA case, 43 out of the 48 SSA countries were considered based on the completeness of data for the identified variables during the period from 1995-2013. The 1995 year as an initial period was considered since comprehensive data for the sampled countries is only available after the year 1995, and these countries were considered for their geographical and socio-economical similarities. Overall, the study period was considered purposively depending upon the pre-surveyed availability of data.

4.4. Variables and their Description

4.4.1. Dependent variables

1. **Life expectancy at birth (LEB)**: is the average equivalent number of years of full health that a newborn 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 was preferred since it has long been used as a measure of health status in literatures as a conventional health status measure. Moreover, in pre identification of the variables it exhibits a stationary pattern after differencing, a basic requirement for time series analysis. Data for this variable was obtained from the World Bank (41, 42).

2. **Infant Mortality Rate (IMR)**: is the number of infants dying before reaching one year of age, per 1,000 live births in a given year. IMR as health status measure was used for the fact that it is more sensitive to changes in health and other socioeconomic conditions of low income economies. Besides, the few available literatures similar issues make use of IMR as a health status measure that help the current study for comparison. This indicator was used for SSA regional specific analysis. The data for this indicator were also obtained from the WB, WDI (41).

4.4.2. Independent variables

1. Development Assistance for Health Expenditure (DAHE): DAHE in this study was the core variable of interest and it referred to health expenditure that originates from external resources for health funds or services in kind that are provided by entities not part of the country in question. The resources may come from international organizations, other countries through bilateral arrangements, or foreign nongovernmental organizations. These resources are part of total health expenditure (60), and a per capita DAHE in current USD was used for this study. Multiple data sources were used for this variable after a thorough examination of alternative sources and this was detailed under the sub section of data sources.

2. Public Health expenditure other than DAHE (PHE'DAH): is also another variable of interest in this study representing recurrent and capital spending from government (central and local) budgets, other than DAHE. The rest of public health expenditure included in the study is considered because health expenditures that originated from local sources are also among the factors known to influence health status of a population as earlier literatures reported (61-64). Similar to DAHE, multiple data sources (41, 42, 60,65-72) were used after a thorough examination of the alternative sources for this variable.

3. GDP per capita (GDPP): GDP per capita in USD is gross domestic product divided by midyear population. GDP per capita is a significant economic factor that affects the health status of the population. As GDP per capita increases, one would expect the standards of living of the people to improve and at the same time reduced mortality and increased life expectancy would also be expected(63, 64) . The data were obtained from WB, WDI starting from year 1981. The data for preceding three years were computed using multiple data imputation methods(41, 42).

4. Total female enrollment in primary education (FEMED): FEMED is expressed as a percentage of the female population of official primary education age regardless of 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 behavior(62,63). 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(41, 73) .

5. Population ages 15 to 64 (POP): POP is the percentage of the total population that is in the age group 15 to 64 years. Population is based on the de facto definition of population(41).

In addition to the above control variables, the following variables were used for SSA countries analysis.

6. Improved sanitation facilities (IMSF):IMSF is defined as a percentage of population with access to improved sanitation facilities, obtained from World Bank (41).

7. Primary year of schooling (PYSC): PYSC defined as the total number of years successfully completed at elementary school, taken from Barro and Lee (74).

8. Governance indicators: These indicators include control of corruption (CCOR), government effectiveness (GOEF), regulatory quality (REQU) and rule of law (RULA),and the data were obtained from World Wide Governance indicator of the World Bank (75).

4.5. Data Analysis

Data description was performed using mean, standard deviation (SD), range, percentage, and graphs. In the application of inferential statistics, P value of 0.01 and 0.05 were taken as significance level.

In dealing with time series data similar to the current country level study, it is important to investigate whether the series are stationary or not because the regression of non-stationary series on another may yield spurious results. Stationarity in a time series refers to a condition where the series has a constant mean and constant variance implying that for a stationary time series, the mean and variance do not vary over time. According to Engle and Grange(76, 77) the parameter estimates from non-stationary time series regression may be biased and inconsistent. Therefore, the most widely used unit root tests, that is, the Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (78) and Philips-Perron (79) both were employed . A concurrent test to determining the long-run relationship among variables under investigation was conducted by employing the Johansen co-integration test(58).

The assumption of normality is one of the most widely used in time series analysis like the current study that helps to estimate and make inferential comparisons and judgments. Violation of this assumption might produce misleading inferences and the result of using unreliable inferences leads to produce misleading interpretations.

In this aspect, the current study regression model assumes that the error terms of the observations are normally distributed. To test this, the recommended Jarque-Bera, Skewness and Kurtosis chi-square test statistics are applied (80, 81) and the result is reported.

The other requirement for the time series study similar to the present model is a test for residual serial autocorrelation. In this aspect the recommended Lagrange Multiplier (LM) test for residual serial autocorrelation is applied (82) and the findings is reported.

4.6. Theoretical Framework

Empirical investigation of the effect of DAH expenditure on health outcome requires specifying theoretical estimating equation. Following the work of Gross man (83), Filmer (63), and Akinkugbe (64) three such equations were derived by transforming implicit functions.

The first model, here after, Model-I, assumes the stability of elasticities of health status with respect to the identified explanatory variables without controlling for the previously existing level of health status. In other words this model assumes that a given percentage change causes some given percentage on health status, irrespective of previously existing level of health status.

Mathematically, if the health outcome at time t is denoted by $Y(t)$ and its determinants at time t by $X_1(t), X_2(t), \dots, X_n(t)$, where the $X_i(t)$ terms include socio-economic, demographic and environmental variables such as DAHE, income, education, population and sanitation, then, from an implicit function:

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

By taking the total derivative of both sides of the equation and dividing both sides by $Y(t)$, one gets:

$$\frac{dY(t)}{Y(t)} = \sum_{j=1}^n \varepsilon_j \frac{dX_j(t)}{X_j(t)} \quad \text{where } \varepsilon_j = \frac{f_j X_j(t)}{Y(t)} \text{ is } Y(t)'s \text{ elasticity with respect to } X_j(t),$$

f_j is marginal effect of $X_j(t)$ on $Y(t)$ and $j = 1, 2, \dots, n$

As pointed above, using the assumption of constant elasticities, one can integrate both sides of the equation, and get:

$$\ln Y(t) = \sum_{j=1}^n \varepsilon_j \ln X_j(t) + \alpha_1 \quad (2)$$

Where α_1 is some constant term.

Thus Model-I, which assumes ε_j are constant is equivalent to stating the required health status estimating equation in a static log-linear form.

The second model, here after, Model-II assumes the stability of the elasticities of health status with respect to its determinants after controlling for the previous level of health status. In other terms, this model assumes the existence of some constant percentage change in health status as a result of a given percentage change in the explanatory variables only for specific previously existing level of health status.

Intuitively, one understands the possibility that the coefficients in the health status estimating equation (2) could be related to the level of health status before change in the explanatory variables take place. That is, keeping other things unchanged, a one percent change in DAHE when the recipient economy exists at a lower level of health status could have much better effects than when similar change in the assistance is applied to another economy with a higher level of health status. This is because in low income countries most often health is endangered due to lack of some very basic necessities of life, which may be fulfilled with low expenses. This phenomenon demands us to control for previous level of health status if we need to find a more refined parametric effects of health aid on health status.

Moreover, in real cases, besides the indicated level effect, the explanatory variables could have lagged effects in addition to their present effects. For instance, DAHE that is channeled at a present time, say, for training of health personnel or buying medical equipment or vehicles or buildings could have current as well as lagged effects. Same is true for other explanatory variables. This condition requires taking of the lagged effects in to account in order to give unbiased coefficient estimate. Notice that under some mathematical restrictions the inclusion of lagged health status level in the equation is equivalent to incorporating all past lagged effects of the explanatory variables. For detail, see appendix (1).

Accordingly, the implicit function of health status that includes the lagged level of health status among the explanatory variables is expressed as:

$$Y(t) = f(Y(t-1), X_1(t), X_2(t), \dots, X_n(t)) \quad \dots\dots\dots(3)$$

Where n is number of explanatory variables.

Just like the case of model-I, taking the derivative of both sides of the equation and dividing both sides by $Y(t)$, we get:

$$\frac{dY(t)}{Y(t)} = \sum_{j=1}^n \varepsilon_j \frac{dX_j(t)}{X_j(t)} + \delta \frac{dY(t-1)}{Y(t-1)} \text{ where } \delta \text{ is } Y(t) \text{'s elasticity with respect to } Y(t-1),$$

Under the indicated assumption one can integrate both sides of the equation and get

$$\ln Y(t) = \delta \ln Y(t-1) + \sum_{j=1}^n \varepsilon_j \ln X_j(t) + \alpha_2 \quad (4)$$

Where α_2 is some constant term.

That is Model-II, which assumes the stability of ε_j after controlling for previous level of health status is equivalent to stating the required health status estimating equation in a dynamic log-linear form. Notice that even if Model- I and Model- II are very common types in empirical researches, both presume the possibility of sustained improvements in health status. That is if one or more of the

explanatory variables exhibit sustained growth, say, like the case of per capita income growth, then these models predict the possibility of sustained growth in health status.

The third model, hereafter, Model-III assumes stability of the product of the elasticities and health status instead of stability of the elasticities. It also assumes stability of marginal effect of previous level of health status on the present level of health status. The implicit function for this model is identical with the Model-II, and expressed in(3) and expressed as:

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

Where n is number of explanatory variables. Here again, by taking the derivative of both sides of the equation we get:

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

f_0 is marginal effect of $Y(t-1)$ on $Y(t)$ and $j = 1, 2, \dots, n$, which can be re-written as

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

Under the assumptions indicated above i.e. constant φ_j 's, one can integrate both sides of the equation, and get:

$$Y(t) = \delta Y(t-1) + \sum_{j=1}^n \varphi_j \ln X_j(t) + \alpha_3 \quad (5)$$

where $\delta = f_0$ and α_3 is some constant term. Notice that under the assumption of constant φ_j 's as health status rises the elasticities will fall and vice versa or rise together. In this process when health status reaches some given maximum the elasticities will take their minimum value. Thus Model-III, is equivalent to stating the required health status estimating equation in dynamic semi-log-linear form.

Notice that Model-III, while retaining most of the useful properties of Model-I and Model-II, avoids the implausible prediction of Model-II that it makes in the cases of extreme level of health status.

Even if the choice among these models is made based on the extent to which they fit to the data, and will be done accordingly, here, the advantage of Model-III is that the coefficient estimates can informs the unit change in health status level as a result of 1% change in the explanatory variables.

To be in the proximity of reality equation (5) needs to be modified more in two major dimensions, specifically regarding the assumptions it makes regarding endogeneity of explanatory variables and equilibrium error.

First a closer look at the equation makes it clear that it assumes away the possibility of feedbacks, while it could be there in real cases. That is, the equation ignores the possibility of endogeneity of explanatory variables or the possibility that health outcome affects the variables. To relax this restrictive assumption, while maintain the main features of the basic equation, each variable is specified in auto regressive form of equation (5) and re-expressed in distributed lag form as:

$$\begin{aligned}
 Y &= \gamma_0 + \sum_{i=0}^n \Psi_{10j} \ln X_1(t-j) + \sum_{i=0}^n \Psi_{20j} \ln X_2(t-j) + \dots \sum_{i=0}^n \Psi_{m0j} \ln X_m + \varepsilon_{0t} \\
 \ln X_1 &= \gamma_1 + \sum_{i=0}^n \Psi_{01j} Y(t-j) + \sum_{j=0}^n \Psi_{21j} \ln X_2(t-j) + \dots \sum_{i=0}^n \Psi_{m1j} \ln X_m + \varepsilon_{1t} \\
 & , \\
 & , \\
 & , \\
 \ln X_m &= \gamma_m + \sum_{i=0}^n \Psi_{0mj} Y(t-j) + \sum_{i=0}^n \Psi_{1mj} \ln X_1(t-j) + \dots \sum_{i=0}^n \Psi_{mmj} \ln X_m + \varepsilon_{mt}
 \end{aligned} \tag{6}$$

where γ_i , Ψ_{ikj} for $i = 1, 2, \dots, m, k = 1, 2, \dots, m$ are parameters and ε_{it} are error terms.

Applying matrix algebra, Equation [6], could be summarized in VAR model form as:

$$Z(t) = \Psi + \sum_{j=1}^{n-1} A_j Z(t-j) + u_t \tag{7}$$

where $Z(t)$ is $m \times 1$ vector of variables, Ψ $m \times 1$ vector of parameters and u_t is random error.

Second, the basic equation assumes away the possibility of short run disequilibrium. It assumes zero equilibrium error, which holds true only in the long-run. However, in real cases in the short run there can be equilibrium error or disequilibrium. To reflect the picture of reality more clearly, making

necessary modification to equation (7) in this dimension would be necessary. For this purpose Granger causality theorem that states that if two variables are co-integrated, then the relationship between the two can be expressed as Error Correction Mechanism is applied. Using this theorem, the ECM of equation (7) will be:

$$\Delta Z(t) = \Phi + \sum_{j=1}^{n-1} A_j \Delta Z(t-j) + \lambda u_{t-1} + \varepsilon_t \quad (8)$$

where λ is rate of adjustment or rate of decline in the error term. Lagging equation (7) by one period and solving for u_{t-1} , one gets

$$Z(t-1) - \Psi - \sum_{j=1}^{n-1} A_j Z(t-j-1) = u_{t-1} \quad (9)$$

Substituting equation (9) in equation (8), one gets:

$$\Delta Z(t) = \Phi + \sum_{j=1}^{n-1} A_j \Delta Z(t-j) + \lambda \left[Z(t-1) - \Psi - \sum_{j=1}^{n-1} A_j Z(t-j-1) \right] + \varepsilon_t \quad (10)$$

After rearranging the equation (10) will be:

$$\Delta Z(t) = \Phi + \Theta Z(t-1) + \sum_{i=1}^{n-1} \Omega_i \Delta Z(t-i) + \varepsilon_t \quad (11)$$

Φ is $m \times 1$ vector of parameters, $\Theta \equiv \sum_{j=1}^n A_j - I_j$, $\Omega_i = -\sum_{j=i+1}^n A_j$ and ε_t has zero mean and constant covariance is i.i.d. normal over time.

Equation (11) is a VECM specification of the extended basic equation (5) that considers endogeneity of explanatory variables on the one hand and that considers short run equilibrium error on the other.

4.7. Empirical Model Specification

Having in place the theoretical framework, the empirical estimation equations for the study were organized both for the time series and the panel data analytic models. While all the three stated models (Model I, Model II, Model- III) specified in the frame work are applied step by step for the Panel analytic approach study of SSA, equation (11) is specifically applied for the country level study.

As mentioned earlier for the SSA level study, a panel data econometric analytic method applied combines cross-section and time series data together to get a more reliable parameter estimates. In forming the panel, for both the dependent and explanatory variables, the time series data of each country were averaged over five years and a total of four time-series data points were formed for each country.

Under the assumption of Model-I stated earlier, the econometric specification that relates health status to a vector of explanatory variables is given as:

$$\ln\text{IMR}(i,t) = \beta_1 \ln\text{DAHE}(i,t) + \beta_2 \ln\text{GDPP}(i,t) + \beta_3 \ln\text{PYSC}(i,t) + \beta_4 \ln\text{IMSF}(i,t) + \beta_5 \text{CCOR} + \beta_6 \text{REQU}(i,t) + \beta_7 \text{RULA}(i,t) + \beta_8 \text{GOEF}(i,t) + \mu_0 + \mu_1(i) + \mu_2(t) + \varepsilon(i,t) \quad (12)$$

Where $\ln\text{IMR}(i,t)$, is log-Infant mortality rate, $\ln\text{DAHE}(i,t)$ is log-health development assistance, $\ln\text{GDPP}(i,t)$ is log-GDP per capita, $\ln\text{PYSC}(i,t)$ is log-primary years of schooling, $\text{CCOR}(i,t)$ is Control of Corruption, $\text{REQU}(i,t)$ is Regulatory Quality, $\text{RULA}(i,t)$ is rule of law and $\text{GOEF}(i,t)$ is Government effectiveness, in country i at time t for $i = 1, 2, \dots, 41$ (number of countries), $t = 1, 2, 3, 4$ (number of time units), $e(i,t)$ is error term with the property $E[e(i,t)] = 0$ and $\text{var}[e(i,t)] = (\sigma_e)^2$; μ_0 is constant term; $\mu_1(i)$ and $\mu_2(t)$ are country and time specific effects respectively. In this specification, β_j 's (elasticity) fulfill the assumptions of Model-I. To estimate equation (12), two estimators were compared and the one that correspond to the data better was selected based on some statistical tests. These estimators were: the fixed effect estimator, that assumes there is constant country-specific effects, and the random effects estimator that assumes there is random country specific effects. To choose from fixed effect and random effect estimator i.e. which fits data better, Hausman specification test was conducted. The estimation results from this approach were presented in Table 9.

As indicated above, equation (5) suggests that if a given dependent variable is specified in an autoregressive form, then that may mean the dependent variable is determined not only by the current effects of explanatory variables but also by their lagged values when we change the autoregressive form to distributive lag form. In our case here, estimation of IMR estimating equation specified in

autoregressive form like equation (5) helps to capture the lagged effects of explanatory variables rather than assuming them away.

Accordingly, equation (12) is re-specified in autoregressive form as:

$$\ln IMR(i, t) = \beta_0 \ln IMR(i, t-1) + \beta_1 \ln DAHE(i, t) + \beta_2 \ln GDPP(i, t) + \beta_3 \ln PYSC(i, t) + \beta_4 \ln IMSF(i, t) + \beta_5 CCOR + \beta_6 REQU(i, t) + \beta_7 RULA(i, t) + \beta_8 GOEF(i, t) + \mu_0 + \mu_1(i) + \mu_2(t) + \varepsilon(i, t) \quad (13)$$

Where $\ln IMR(i, t-1)$ is log of IMR lagged by one period for county i , and other variables and parameters are as defined in equation (12).

Furthermore, under the assumption of Model-III above, the econometric specification that relates the dependent variable (IMR) to the vector of explanatory variables is given as:

$$IMR(i, t) = \beta_0 IMR(i, t-1) + \beta_1 \ln HDA(i, t) + \beta_2 \ln GDPP(i, t) + \beta_3 \ln PYSC(i, t) + \beta_4 \ln IMSF(i, t) + \beta_5 CCOR + \beta_6 REQU(i, t) + \beta_7 RULA(i, t) + \beta_8 GOEF(i, t) + \mu_0 + \mu_1(i) + \mu_2(t) + \varepsilon(i, t) \quad (14)$$

where $IMR(t-1)$ is lagged value of dependent variable-IMR and other the variables are as defined in equation [12] above. In this specification, β_j 's (elasticities) fulfill the assumptions of model-III.

The suitable estimator for dynamic panel models like equation (13) or (14) would be either the first difference generalized method of moments (GMM) developed by Arellano and Bond (84) or system GMM developed by Blundell and Bond (85) depending on the nature of the error terms. In general log of IMR is expected to have an autoregressive parameter far lesser than unity because the series tends to move to some stable level, say, close to zero instead of persistently falling or rising at some constant rate. But Alonso-Borrego and Arellano (86) indicated that system GMM is more appropriate in the cases where autoregressive parameter is closer to unity. Hence, here, first difference GMM is preferred to system GMM. Using first difference GMM estimator equation (13) and equation (14) are estimated and the estimation results are presented in Table 10.

Shifting to country level empirical modeling, equation 11 is considered and the corresponding variables are specified as:

$$\begin{aligned} LEB(t) = & \psi_1 + \sum_{j=0}^n \varphi_{1j} LnDAHE(t-j) + \sum_{j=0}^n \mu_{1j} LnGDPP(t-j) + \sum_{j=0}^n \beta_{1j} FEMED(t-j) \\ & + \sum_{j=0}^n \alpha_{1j} LnPOP(t-j) + \sum_{j=0}^n \gamma_{1j} PHEDAH(t-j) + \varepsilon_{1t} \end{aligned} \quad (15)$$

$$\begin{aligned} LnDAHE(t) = & \psi_2 + \sum_{j=0}^n \delta_{2j} LEB(t-j) + \sum_{j=0}^n \mu_{2j} LnGDPP(t-j) + \sum_{j=0}^n \beta_{2j} FEMED(t-j) \\ & + \sum_{j=0}^n \alpha_{2j} LnPOP(t-j) + \sum_{j=0}^n \gamma_{2j} PHEDAH(t-j) + \varepsilon_{2t} \end{aligned} \quad (16)$$

$$\begin{aligned} LnGDPP(t) = & \psi_3 + \sum_{j=0}^n \delta_{3j} LEB(t-j) + \sum_{j=0}^n \varphi_{3j} LnDAHE(t-j) + \sum_{j=0}^n \beta_{3j} FEMED(t-j) \\ & + \sum_{j=0}^n \alpha_{3j} LnPOP(t-j) + \sum_{j=0}^n \gamma_{3j} PHEDAH(t-j) + \varepsilon_{3t} \end{aligned} \quad (17)$$

)

$$\begin{aligned} FEMED(t) = & \psi_4 + \sum_{j=0}^n \delta_{4j} LEB(t-j) + \sum_{j=0}^n \varphi_{4j} LnDAHE(t-j) + \sum_{j=0}^n \mu_{4j} LnGDPP(t-j) \\ & + \sum_{j=0}^n \alpha_{4j} LnPOP(t-j) + \sum_{j=0}^n \gamma_{4j} PHEDAH(t-j) + \varepsilon_{4t} \end{aligned} \quad (18)$$

$$\begin{aligned} LnPOP(t) = & \psi_5 + \sum_{j=0}^n \delta_{5j} LEB(t-j) + \sum_{j=0}^n \varphi_{5j} LnDAHE(t-j) + \sum_{j=0}^n \mu_{5j} LnGDPP(t-j) \\ & + \sum_{j=0}^n \beta_{5t} FEMED(t-j) + \sum_{j=0}^n \gamma_{5j} PHEDAH(t-j) + \varepsilon_{5t} \end{aligned} \quad (19)$$

Where LEB is Health outcome as measured by life expectancy at birth, LnDAHE is log of Development Assistance for Health Expenditure per capita in current USD, PHEDAH is the rest of Public Health Expenditure other than DAHE in per capita current USD, LnGDPP is log of per capita Gross Domestic Product in current USD, FEMED is total Female enrollment in primary Education, LnPOP is log Population aged 15 to 64, $\psi_{ij}, \delta_{ij}, \varphi_{ij}, \mu_{ij}, \beta_{it}, \alpha_{ij}$ and γ_{ij} are parameters for $i=1,2,\dots,m$ and m total number of variables in the model, $j=1,2,\dots,n$ and n is total number of lag, ε_{it} are error terms.

4.8. Data Collection Technique and Tools

Data collection tools included semi-structured questionnaire and checklists of indicators that were categorized to capture the logical flow of information and to ease analysis in a more rational approach. The data compilation forms were designed and standardized in such a way that the items of data can be transferred in the order in which the items appear in the source document to save time and reduce error. Two trained data collectors who have previous knowledge of accounting, supervised by principal investigator collected the data.

4.9. Data Source

Collecting such large data set with higher quality at the individual investigator level would be unfeasible. Therefore, the data were collected from internationally and nationally recognized organizations, mainly from the World Bank; world development Indicator (41, 42) World Health Organization (60); global health expenditure data base, Data Set of Educational Attainment in the World (74), Ministry of Finance and Economic Development (70, 71) Ethiopia, Central Statistical Agency of Ethiopia (65-69), Federal Ministry of Health (72) Ethiopia. All these were publically available data sources and were exhaustively examined, cross-checked for alternatives, and thoroughly chosen from the best alternatives.

In the current study, for the advantages of saving resources (money, time), accessibility, and maintaining high quality of the required data, secondary data from the above international and national sources are used. Such secondary data sources are also advantageous in longitudinal studies like the current study in providing regular, continuous long-term data that help comparing countries.

Therefore, the best alternative is considered among all the possible alternatives data sources as elaborated in the next section.

4.10. How the DAHE data were tracked for the study

The following data sources were first identified; Organization for Economic Co-operation and Development (OECD), Project-Level Aid (PLAID), Institute for Health Metrics and Evaluation (IHME), Global health expenditure database maintained by WHO, Central Statistical Authority

(CSA) of Ethiopia, Ministry of Finance and Economic Cooperation (MoFEC) of Ethiopia, Federal Ministry of health (FMOH) , Ethiopia, and World Bank(WB) World Development Indicator (WDI).

After identification, these data sources were examined for the appropriateness, comprehensiveness, and completeness. The advantages and disadvantages of the sources were further explored from the existing evidence (43, 87,88). As described below, the final best alternative was considered after extensive explorations.

First, OECD - Development Assistance Committee (DAC) data were explored. This source is the most common source of information on DAH that has long been existed since 1960s (86). The data comes from the OECD Development Assistance Committee (DAC), which collects on an ongoing basis data on aid and other resource flows to developing countries from member institutions, some multilateral organizations, and other donors. While this source provides the longest times series of any dataset on aggregate commitment and disbursement aid data, the disaggregated aid expenditure on health sector data was not captured fully in this source and time series data points for Ethiopia is even less. Besides, this source reports only limited data from selected global health initiatives and non-DAC bilateral donors and does not include data from non-governmental organizations (NGOs) or foundations, with the exception of few (86).

Therefore, an alternative data source considered next was the relatively recent, PLAID dataset that was expected to overcome the limitation of OECD – DAC data for the current study. PLAID dataset that is developed by researchers at the College of William and Mary and Brigham Young University in the US. It has built on the OECD dataset by including data from more non-DAC bilateral and other donors, collecting data directly from multilateral donors. This data source includes more data from non-DAC bilateral donors, as well as additional multilateral and inter-governmental organizations as an advantage over OECD-DAC data (86). However, for this specific study, many of the time series data required were found to be only commitments with few data points on disbursements, in which neither of the two provide full pattern of DAH expenditure for health that the current study intended to consider.

The other alternative was the IHME database, which unlike the previous two databases, developed specifically to track health projects since 1990. The databases contain estimated disbursements from both public and private sources, including foundations. As is with PLAID, in this database, multilateral donors are tracked using information obtained directly from the donors instead of using the data from OECD- DAC, which is incomplete for some multilateral donors. However, IHME DAH databases only includes the contributions of non-DAC donors to the European Commission, the World Bank, UN Agencies and public-private partnerships that are tracked through these institutions' income statements, but does not include direct transfers to developing countries (86). For this specific study with the preference to use actual DAH expenditure data, this data base was unable to provide the full pattern of the intended DAH expenditure similar to the above two sources.

Another possible alternative examined was the global health expenditure database that WHO has been maintained since 1995. This data source provides internationally comparable numbers on national health expenditures with a source from external resources. It is updated annually based on publicly available reports, national health account reports, reports from the ministry of finance, central Bank, National Statistics Offices, public expenditure information and reports from the World Bank, the International Monetary Fund, etc. and the report are sent out to the Ministries of Health for validation prior to publication (60). This data source provides the intended DAH expenditure data, which originates from the recipient countries report. However, the available length of the time series data for the country level study was not sufficient as it only captures data since 1995. To complement the data points prior to 1995, national data sources were tracked from CSA, MoFEC and FMOH, particularly for the country specific study. However, the data prior to the year 1995 is limited to the on line budget data only, and does not capture the other health aid data. Hence, this was one limitation to this study.

At last, data from WB world development indicator also provided similar data with Global health expenditure data, is used as a supplementary source to the global health expenditure database by WHO (41, 42, 73).

4.11. Data Processing

The data was checked and rechecked for completeness before and during data processing. STATA 11.00, and Excel spreadsheet were extensively used depending on the suitability of the program to ease the analysis. For example, excel was mainly used for compiling and organizing the data. STATA 11.00 was used for the remaining descriptive and advanced regression analysis. Categorizing, coding, and verification were also made carefully.

4.12. Ethical Considerations

The Institutional Review Board (IRB) of College of Health Science, Addis Ababa University (AAU) granted ethical clearance. As can be understood, the study does not include human subjects as a study participant and the ethical concern of the study participants is not as such a major concern in this study.

Besides, the research used secondary data sources and documents that are publically available. Thus, all the data sources and the cooperation of the concerned public offices were acknowledged accordingly.

4.13. Dissemination of findings

The findings of this study will be disseminated to Addis Ababa University School of public Health, Ministry of Health, and other regional and international concerned communities through reports and publication on an appropriate journal.

5. Results

5.1. Ethiopia, the Country level study

5.1.1. Descriptive results

As the descriptive results shows, in Table 1, the Mean (SD) of LEB and DAHE during the sampled period of the study were 51(6.44) and 1.73(2.61) respectively. The range was between 43.67 and 63.62 for LEB, 0.05 and 9.06 for DAHE. Similarly, the mean (SD) for the remaining variables, namely, GDPP, PHE'DAH, FEMED, and POP were 218.92(96.34), 1.62(1.66), 46.16(27.59), and 3.06E+07 (9940617) respectively. For detail, see Table 1.

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

Variables	Definitions	Obs	Mean	Std. Dev.	Min	Max
LEB	Life expectancy at birth	36	51.069	6.437	43.674	63.617
DAHE	Development assistance for health expenditure per capita	36	1.727	2.612	0.050	9.057
GDPP	Gross domestic product per capita	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 school enrolment ratio	36	46.157	27.585	13.906	100.546
POP	Total Population aged 15 to 64 years	36	3.06E+07	9940617	1.80E+07	5.10E+07

At the same time, Fig.1 illustrates trends in LEB and DAHE in Ethiopia during the period of the study. As can be observed from the figure, starting from the mid-1980s, LEB follows a steady upward trend without interruption throughout the observation period. However, a more pronounced upward trend in LEB was observed after the year 2000 up to the end of the study period (Fig 1). While looking in to the pattern of DAHE, the change from 1978 to 1994 is minimal and small in amount (around 0.5 USD). After 1995, there was a slight upward increment until 2000, and followed by a small down ward. A sharp increasing trend was observed between 2003 and 2008 with slight decrease trend in 2009, then gain upward trend until the year 2012. Then after, there was a hint of a declining trend as can be seen in the Figure 1. The trends in DAHE and LEB illustrated in Figure 1

therefore, briefly informs that the country has experienced an improved health outcomes as measured by LEB and at the same time an increasing trend in DAHE in general. However, the visual observation from this illustration provides only the preliminary steps for further analysis.

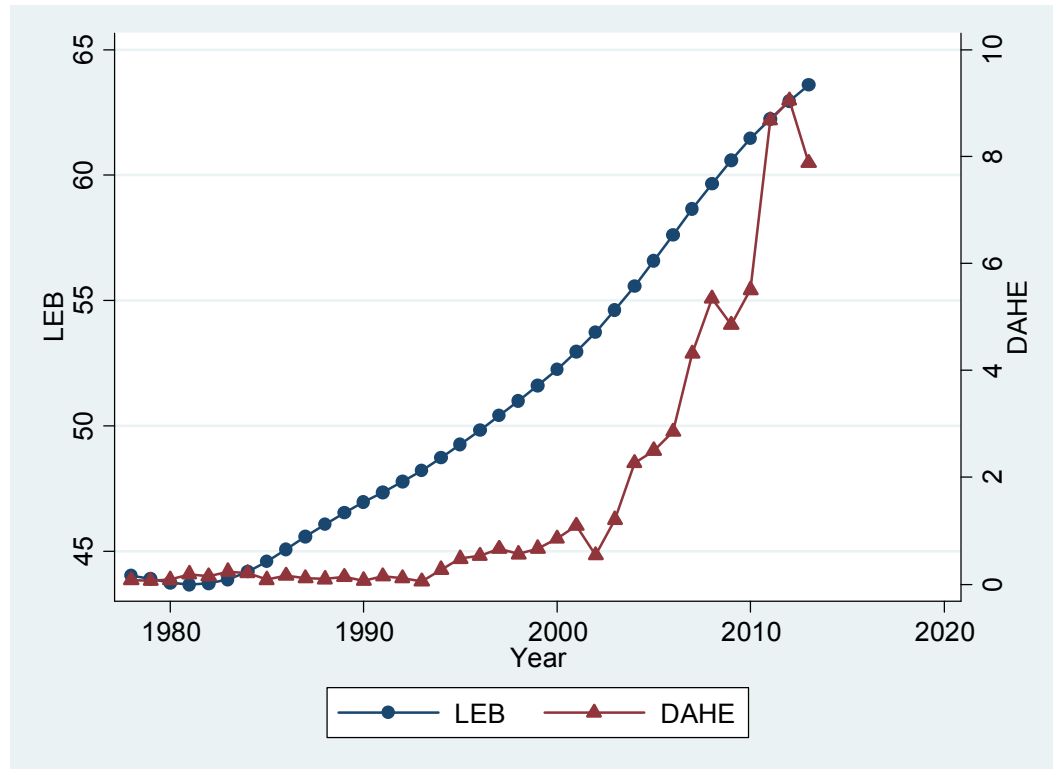


Figure 1. Trends in LEB and DAH in Ethiopia 1978-2013

A trend observation of DAHE and LEB after considering the log transformation is more informative as shown in the Figure 2. As one can observe from the figure, the logarithm of LEB shows constant increasing overtime after early 1980s. At the same time, DAHE is also increasing overtime with a given fluctuations until the mid-1990s, then after, with continuous increase over the period of the study. Similar to the observation in Figure 1, both DAHE and LEB show a positive increasing trend over the time of study. Here again, based on this visual observation, a conclusion that the DAHE can explain LEB cannot be reached at this step.

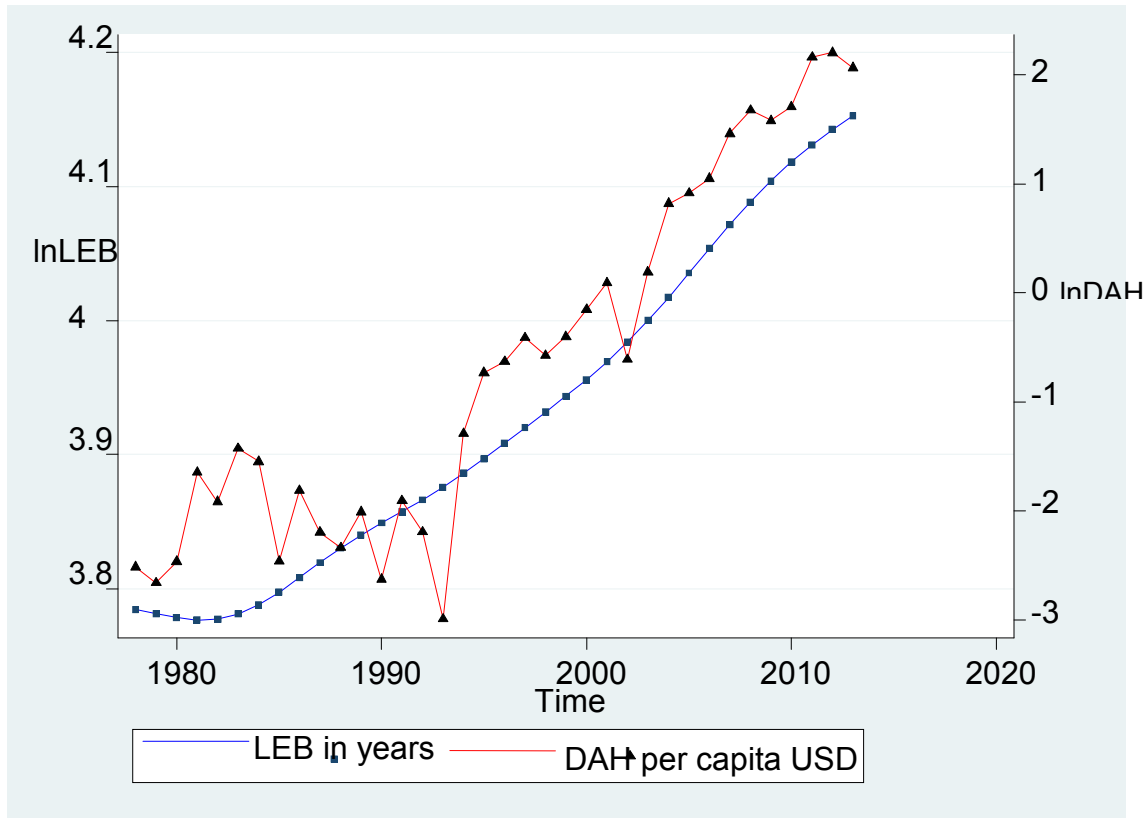


Figure 2. The trend relationship of DAHE and LEB, Ethiopia, 1978-2013.

The other way of looking in to the relationship between DAHE and LEB is by plotting a local polynomial smoothing curve that gives a more insight to the change of LEB on DAHE as illustrated in Figure 3. The figure informs that, DAHE is increasingly effective in continuous, and steady increasing of LEB from about 1.00 USD per capita to about 7.00 USD per capita while the change seems to be constant then after. Even if the positive relationship is clearly observed here again, at this step, one cannot conclude about the causal effect of DAHE on LEB and it requires an econometric investigation.

Therefore, based up on this preliminary suggestive observation of the influence of DAHE on health status, further econometric analysis is imperative to come up with a more refined conclusion of the effect of the variable under the study as shown in the following successive sections.

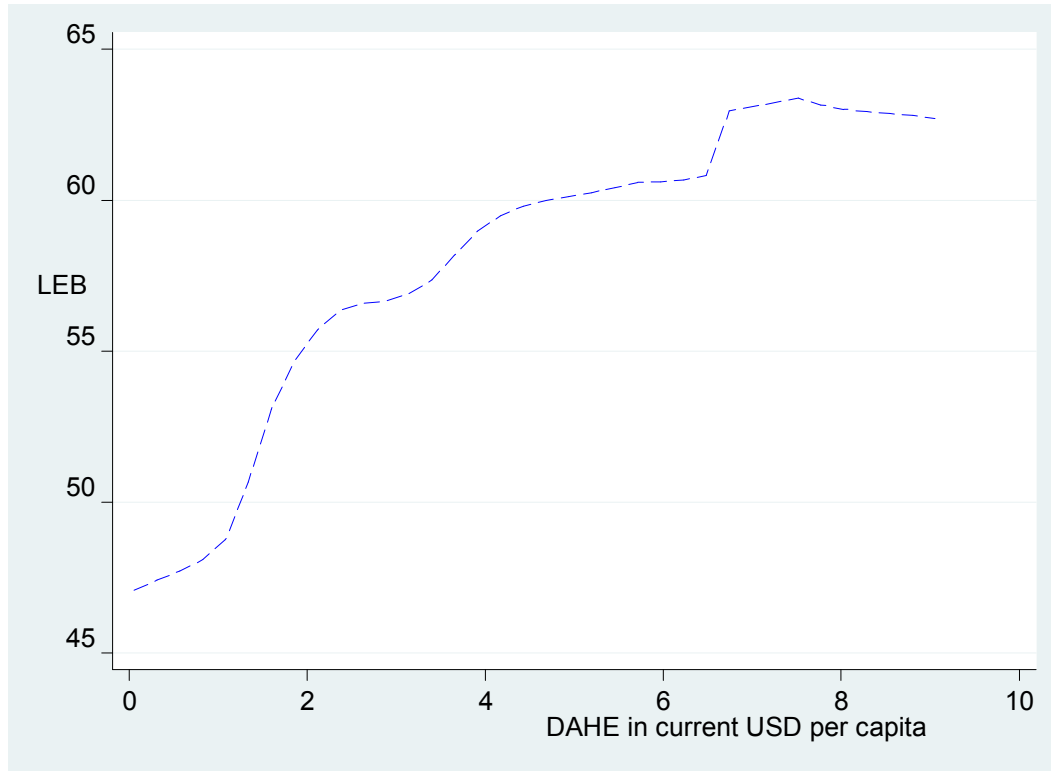


Figure 3. A plot of local polynomial smooth curve of LEB DAHE, Ethiopia, 1978-2013.

5.1.2. The Unit root test

The analysis of data under the current study proceeds by testing for stationarity of each series as is common in time-series data analysis. All the included variables (LEB, DAHE, GDPP, PHE, DAH, FEMED, POP) were undergone the test to avoid the spurious results that would make the estimate biased and inconsistent (77,93). The results from the test based on Augmented Dickey Fuller and Philip-Perron are presented in Table 2. Both tests, though consistent with each other, are included to ensure accuracy regarding the unit root conclusion.

The tests allow for the presence of both intercept and trend and without intercept and trend both at level and first difference. Accordingly, the result shows that all the variables at level are not stationary, but after the first differencing, they all display a stationary behavior (Table 2.). Therefore it can be surmised that the estimated variables are integrated of order one, $I(1)$ process that guarantee to proceed to the next step of examining the presence of long run equilibrium relationship between DAHE and LEB in the regression through the multivariate Johansen-Juselius co-integration test (93).

Table 2. ADF unit root test results at level and first difference, Ethiopia, (1978-2013).

	With Intercept no trend		With Intercept and trend	
	Levels	1 st Difference	Levels	1 st Difference
lnLEB	7.584	-3.008*	-2.307	-6.982**
lnDAHE	-0.519	-7.571**	-2.598	-7.503**
lnGDPP	0.449	-3.406*	0.222	-3.678*
lnPHE-DAH	-0.811	-6.970**	-2.984	-6.852**
lnFEMED	-0.114	-3.108*	-1.085	-4.036**
lnPOP	4.318	-4.006**	-2.529	-3.396*

*Null hypothesis rejected at 5%, **Null hypothesis rejected at 1%.

5.1.3. The co-integration test

As a standard, co-integration test provides a framework for estimation, inference and interpretation in non-stationary data with first difference stationary like the current analysis, (93).

Therefore, in this study, Johansen method of co-integration test (93) is applied to ascertain the existence of convergence between the long run equilibrium and the short run dynamics of the data under the study. In the output of Johansen tests for co-integration as indicated in Table 3, the null hypotheses of no co-integration is strongly rejected and fail to reject the null hypothesis of at most one co-integrating equation. Thus, the model accepts the null hypothesis that there is one co-integrating equation in the targeted variable model (Table 3).

Table 3. The Co-integration rank results, Ethiopia, (1978-2013).

Co-integrating Vector (lnLEB, lnDAHE, lnGDPP, lnPHE-DAH, lnFEMED,lnPOP15-64)		
Null Hypothesis (Maximum rank)	Trace-Statistics	Maximum Eigen Statistics
r=0	67.669	36.024
r=1	31.645*	22.115
r=2	12.568	11.118
r=3	9.529	8.516
r=4	1.450	1.440
r=5	0.763	0.763

**Null hypothesis rejected at 1%*

The explicit choice of lag – length is required to proceed with the analysis of the model under consideration. Accordingly, the Akaike information criterion (AIC) is used to determine the lag length of the model. The AIC is chosen for decision in the current study because Liews (93) suggests that AIC performed better than any other information criteria when the estimated sample size is relatively small (e.g. less than 60 observations) like this study. However in the current study similar output is conveyed by Schwarz Bayesian information criterion (SBIC), Hannan-Quinn information criteria (HQIC) sequential likelihood-ratio (LR) test as shown in Table 4. Akaike information criterion (AIC) and its companion criterion all indicate to choose three lags, as indicated by the “*” in the Table 4.

Table 4. The Lag order selection statistics, Ethiopia, (1978-2013).

lag	LL	LR	AIC	HQIC	SBIC
0	-122.331	NA	8.0214	8.0515	8.1139
1	-0.913	242.840	0.446	0.536	0.724
2	35.943	73.711	-1.674	-1.523	-1.211
3	68.630	65.375*	-3.525*	-3.313*	-2.877*
4	105.907	74.554	-5.672	-5.401	-4.839

5.1.4. Result from ECM

It has been determined that there is stationarity and co-integration of the series between the variables in the regression model as stated previously. Next, to account for the relationship of variables, both in the short-run and in the long-run, the Error Correction Method (ECM) is employed. Consequently, the ECM relates the short run changes in LEB to the short run changes in the DAH (the main variable of interest), and the remaining explanatory variables in the model in linking with the changes in the long run effect. The result is depicted in Table 5.

The result shown in the Table 5 reveals that the long run relationship among the variables in the model is well captured by the specified ECM term (ECM-1), and the coefficient estimate of ECM-1 is negative and significant at 1% level explaining the speed of adjustment between the short run and long run, though slow.

As can be seen from the table 5, the estimated coefficient EC_{t-1} is -0.011 implying that about 1.1% of the disequilibrium in the previous year (year $t-1$) in LEB are corrected in the current year period. The result further displays that the variables in the model are all in the first differenced form representing the short run elasticity of LEB with regard to DAHE and the remaining explanatory variables.

As the result shows, the short run effect of DAHE on LEB is positive and significant. The immediate past period of DAHE significantly affect the current level of LEB positively at 1% significance level, implying that other things being equal, an increase of DAHE by 1% leads to an improvement in life expectancy at birth by approximately 0.026 years or about 9 days ($P=0.000$).

Similarly, the result suggest that there is a statistically significant positive association between the two immediate past period of DAHE and LEB, suggesting a 1 % increase in DAHE the two immediate past period improves the current LEB by about 0.008 years or about 3 days ($P=0.025$). The association of the rest of Public health expenditure during the immediate two previous period is also positive and significant ($P=0.013$), indicating a 1 unit increase of PHE-DAH during the immediate two previous year leads to similar 3 days improvement in current LEB like that of DAHE effect of immediate two previous year. The immediate one previous year of PHE-DAH is insignificant, while the joint effect of the two periods was found to be significant (Table 5).

Table 5. The ECM estimation results, Ethiopia (1978-2013).

Variables	Coefficient	Std. Err.	t-Values	probability
ECt-1	-0.011	0.001	-9.070	0.000
LEB LD.	1.822	0.039	46.870	0.000
LEB L2D.	-1.080	0.052	-20.930	0.000
lnDAHE LD.	0.026	0.004	6.160	0.000
lnDAHE L2D.	0.008	0.004	2.240	0.025
lnGDPP LD.	0.083	0.023	3.600	0.000
lnGDPP L2D.	0.086	0.024	3.620	0.000
PHE-DAH LD**.	0.004	0.003	1.390	0.166
PHE-DAH L2D**.	0.008	0.003	2.480	0.013
FEMED LD.	-0.0004	0.001	-0.770	0.442
FEMED L2D.	-0.0002	0.001	-0.360	0.715
lnPOPLD.*	2.056	1.279	1.610	0.108
lnPOPL2D.*	-2.459	0.958	-2.570	0.010
_cons	0.863	0.085	10.200	0.000
<i>LM test at: Lag 1;χ^2 (27.520),P= 0.844.Lag 2;χ^2 (29.157),P= 0.784</i>				

***indicates that the Joint effect is significant, *indicates that the Joint effect is insignificant*

The association between GDPP and LEB is also found to be statistically significant ($p=0.000$) and positive, both during the immediate one and two previous years. A 1% increase in GDPP improves the current level of LEB approximately by 0.08 year or about by 1 month. Table 5, further displays 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, 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 as shown in Table 5.

5.1.5. Post-Estimation Diagnostics Test

5.1.5.1. The Normality test

Among the requirements for the current model, is a test of normal distribution of the error terms in the regression model. Consequently, the normality test is employed to ascertain this and the result is depicted in the Table 6. In this test, the null hypothesis for the Jarque-Bera statistics is that the error term in the model equation has normal distribution. In the current model, the overall Jarque-Bera statistics does not reject the null of normality at 5%. Similarly, the null hypothesis test that the error terms in all equations jointly in the model have zero skewness is not rejected at 5% significance level; hence, the result does not suggest non-normality as shown in the Table 6. At the same time, the Kurtosis statistics presented in the Table6, tests the null hypothesis that the disturbance terms are normally distributed is consistent with normality since the result fail to reject the null hypothesis at 5% significance level (Table 6).

Table 6. The test for normal distribution of residuals

Component	Test Criterion	Joint χ^2	Probability
6	Jarque-Bera	8.820	0.718
6	Skewness	6.977	0.323
6	Kurtosis	1.843	0.934

5.1.5.2. Test for residual serial autocorrelation

As presented in Table 5 (last row) the results of the Lagrange Multiplier (LM) test for residual serial autocorrelation, imply that there is no problem of autocorrelation in the estimated model at 5%,as the test fail to reject the null hypothesis of no autocorrelation among residuals.

5.2. Sub Saharan Africa: The Regional Level Results

5.2.1. Descriptive results

A trend in DAHE as a percentage share of total health expenditure for Ethiopia and SSA countries is displayed in Fig.4. As the figure shows, total expenditures share of DAHE is high in Ethiopia compared to SSA countries during the period from 1995 to 2013. The difference is more remarkable during the period between 2005 and 2011. In other words Ethiopia had been receiving high volume of DAHE than average SSA. The regional difference between SSA and LAC countries is also noticeable. On average, SSA were getting more than two fold of DAH than LAC countries between 1995 and 2013 (Fig 4).

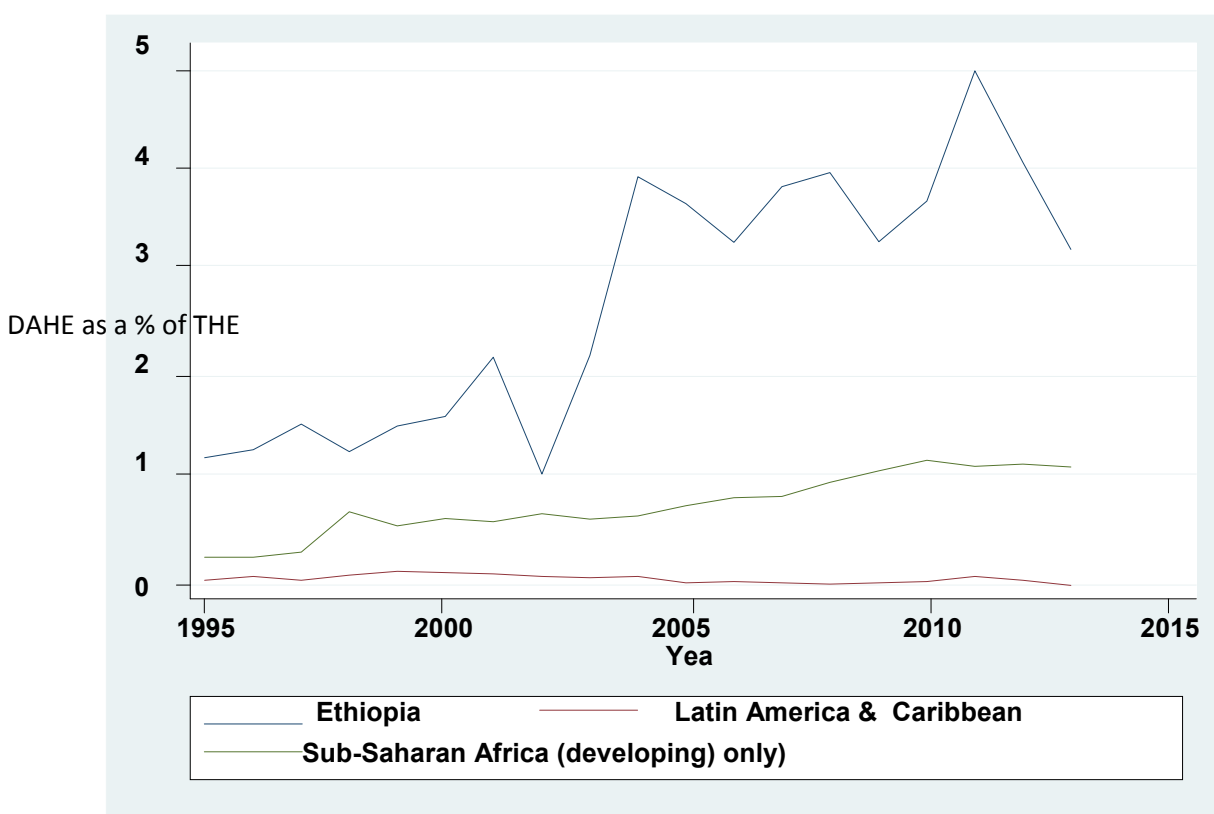


Figure 4. Trends in DAHE as % of total expenditure on health in Ethiopia, SSA and LAC* countries 1995-2013

*LAC trend in DAHE is indicated here only for comparison purpose.

At the same time, Fig 5, displays progresses in the health status in Ethiopia, SSA and LAC during the period from 1995-2013 showing a noticeable progress, particularly in Ethiopia. Compared to LAC, there is wide gap in LEB at the initial year of 1995, which is about 20 years difference in LEB. However, it seems that Ethiopia managed to narrow this gap by about 10 years while the average SSA is lagging by about 18 years in 2013 (Fig 5).

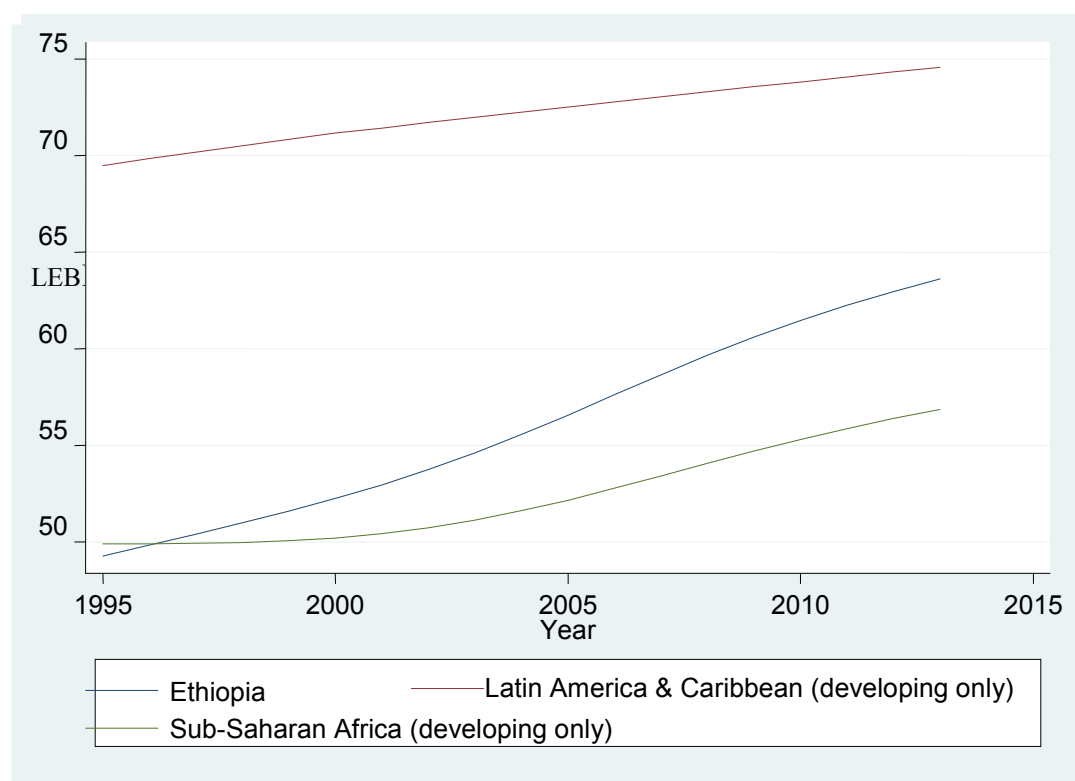


Figure 5. Trends in LEB at birth in Ethiopia, SSA(1990-2010).

As indicated on Table 7, during the study period 1990-2010, the estimated average infant mortality per 1000 live births was 82 in SSA countries. According to the dataset, it was as high as 165 in Liberia in 1990, 155 in Mozambique in 1990 and 153 in Sierra Leone in 1990 per 100 live-births. In 2010 the good performances were observed in Seychelles (12 infants), Mozambique (13 infants) and South Africa (35 infants). The mean per capita of DAHE and GDPP in the region were 5.80 and 1411.70, respectively, both in constant 2005 USD dollars.

In 2010 the major DAH per capita recipient countries were Namibia (58.4 USD), Botswana (27.5 USD), Seychelles (29.4 USD) and Swaziland (28.2 USD). Moreover, the Table 7 informs that in the

region only 29.6% of the population has access to improved sanitation facilities during the study period. According to the statistics, countries that exhibited good performance in this dimension were Equatorial Guinea 88.9% in 2005, Mauritius 88.9 % in 2010 and Seychelles 97.1% in 2010 and South Africa 73% in 2010. On the other side in year 2010, countries that have shown relatively lower performance were Niger 8.6%, Malawi 10.3 %, Togo 11.5, Chad 11.5%, Tanzania 11.6% Sierra Leone 12.8 % and Madagascar 13.4 %.

Table 7also informs that during the covered period of study, in the region the mean indices of control of corruption, rule of law, regulatory quality, and government effectiveness were below zero. The data suggests that in year 2010 control of corruption index were relatively high in Botswana (1.003), Mauritius (0.65), Namibia (0.32), Rwanda (0.46), and Seychelles (0.29).

Table 7. Health and the related indicators summary statistics across SSA (1990-2010)

Variable	Obs	Mean	Std. Dev.	Min	Max
IMR	215	81.8	30.9	11.7	165.2
DAHE	172	5.80	7.30	0.00	58.39
GDPP	214	1411.70	2324.63	50.04	12645.08
IMSF	205	29.61	22.83	2.40	97.10
PYSC	155	3.31	1.41	0.74	6.28
CCOR	172	-0.6012	0.6209	-2.0575	1.1413
RULA	172	-0.7471	0.6587	-2.2298	1.0069
REQU	172	-0.6699	0.6181	-2.2490	0.8980
GOEF	172	-0.7473	0.6206	-1.9606	0.8765

In the same year Equatorial Guinea (-1.49), Democratic Republic of Congo (-1.42), Chad (-1.33) and Angola (-1.32) were found to show low performance in this indicator. Based on these governance indices in 2010 Botswana and Mauritius were found to exercise rule of law better than other countries, 0.66 and 0.86, respectively. In the same year, these two countries have shown better performance in government effectiveness as well, Botswana (0.46) and Mauritius (0.84). On the opposite side this indicator was low in Comoros (-1.74), Democratic Republic of Congo (-1.73) and Equatorial Guinea (-1.7).

5.2.2. Estimation Results

The estimation results from the three early mentioned approaches were presented in Table 8, and 9 consequently as follows.

Table 8. Estimation results from fixed effect and Random effect, SSA (1995–2010)

Fixed Effect					Random Effect			
Variable	Coef.	Std.err.	t	P>t	Coef.	Std.err	z	P>z
LNDAHE	-0.012	0.014	-0.850	0.396	-0.051	0.014	-3.680	0.000
LNGDP	-0.417	0.117	-3.570	0.001	-0.117	0.055	-2.150	0.032
LNIMSF	-0.121	0.144	-0.840	0.402	-0.167	0.073	-2.300	0.022
LNPYSC	-0.729	0.152	-4.800	0.000	-0.343	0.097	-3.550	0.000
CCOR	0.043	0.064	0.670	0.505	0.074	0.070	1.060	0.289
RULA	-0.183	0.073	-2.490	0.015	-0.295	0.076	-3.910	0.000
REQU	0.024	0.066	0.370	0.715	0.065	0.073	0.890	0.373
GOEF	-0.043	0.083	-0.510	0.608	-0.004	0.089	-0.050	0.961
_CONS	8.097	0.709	11.420	0.000	5.890	0.332	17.750	0.000
sigma_u=0.584;sigma_e=0.112;rho=0.964					sigma_u=0.206;sigma_e=0.112;rho=0.772			
Hausman test chi2(8)= 41.53 Prob>chi2 = 0.0000								

According to the identified fixed effect estimator results in Table 8, except CCOR and REQU all explanatory variables have coefficient estimates with the expected sign, negative. However, except LNGDPP, LNPYSC and RULA all the coefficient estimates were found to be statistically insignificant. Nonetheless, the insignificance may not necessarily be the reflection of the real image of the issue under consideration. Instead, it could be the distortion that might have arisen due to possible misspecifications error committed in a form of omitted variables or wrong functional form.

The Hausman test presented at the bottom of the Table 8 rejects the null hypothesis that states the error terms are independent of the explanatory variables, which imply that the fixed effect estimator is preferable to random effect, $\chi^2_{(8)}=41.53$, $p=0.000$.

To refine the results more in this direction, we estimated equation (4) and equation (5) using first difference GMM estimator and the estimation results are presented in Table 9

Table 9. Estimation results from first difference GMM,SSA (1995-2010)

Model-II					Model-III				
Variables	Coef.	Std.	Z	P>z	Variables	Coef.	Std.	z	P>z
LNIMR L1.	0.670	0.104	6.450	0.000	IMR L1.	0.465	0.141	3.300	0.001
LNDAHE	-0.026	0.009	-2.770	0.006	LNDAHE	-1.973	0.458	-4.310	0.000
LNGDPP	-0.237	0.083	-2.840	0.004	LNGDPP	-9.964	6.015	-1.660	0.098
LNIMSF	-0.221	0.079	-2.790	0.005	LNIMSF	-19.182	6.764	-2.840	0.005
LNPYSC	-0.257	0.126	-2.040	0.042	LNPYSC	-31.633	10.136	-3.120	0.002
CCOR	0.062	0.036	1.720	0.085	CCOR	5.336	2.156	2.480	0.013
RULA	-0.143	0.056	-2.530	0.011	RULA	-12.845	4.826	-2.660	0.008
REQU	0.097	0.044	2.180	0.029	REQU	4.989	3.538	1.410	0.159
GOEF	-0.070	0.038	-1.860	0.063	GOEF	-5.087	2.967	3.300	0.001
_CONS	3.857	0.964	4.000	0.000	_CONS	196.032	58.225	-4.310	0.000
<i>Arellano-Bond test for AR(1) in first differences: $\hat{\alpha} = -0.272$ $Pr > \hat{\alpha} = 0.786$</i>					<i>Arellano-Bond test for AR(1) in first differences: $\hat{\alpha} = -0.441$ $Pr > \hat{\alpha} = 0.659$</i>				
<i>Arellano-Bond test for AR(2) in first differences: $\hat{\alpha} = -1.182$ $Pr > \hat{\alpha} = 0.237$</i>					<i>Arellano-Bond test for AR(2) in first differences: $\hat{\alpha} = -1.012$ $Pr > \hat{\alpha} = 0.312$</i>				
<i>Wald $\chi^2(9) = 320.91$ $Prob > \chi^2 = 0.000$; Number of</i>					<i>Wald $\chi^2(9) = 527.13$ $Prob > \chi^2 = 0.000$; Number of obs= 91;</i>				

For Model-II, Table 9 reports that for the panel countries under consideration the Arellano-Bond test for AR(2) in the first difference accepts the null hypothesis that states the moment conditions are valid, which holds only if there is no serial correlation in the idiosyncratic errors. That is the test confirms the hypothesis that the instrumental variables are acceptable for they fulfill the condition that they need not be correlated to the residuals.

Moreover, Table 9 reports that for these countries the Wald test rejects the null hypothesis that states all the coefficients except the constant term are zero. Furthermore, the table reports that the coefficient of the lagged dependent variable is 0.670 that is statistically significant, $z = 6.45$ $Pr > z = 0.000$. This suggests that in the estimation process of coefficient of LNDAHE, unlike Model-I that assumes away effect of lagged variables, controlling for previous level of IMR is necessary.

Furthermore, the estimator gives -0.026 as the coefficient estimate of log-DAHE, which is strongly significant, $z = 2.77$ $\Pr > z = 0.006$, suggesting that, during the covered period of study, DAHE per capita has a statistically strong reducing effect on IMR. It indicates that in the region a 1% increase in DAHE reduces IMR by 2.6%. In other words, this result supports the belief that health development assistance has got a strong favorable effect in improving health status of the region.

Similarly, the estimator gives -0.237 for log-GDPP, -0.221 for lnIMSF and -0.257 for the LNPYSC as the coefficient estimates that are statistically significant, $p=0.004$, $p=0.005$ and $p=0.042$, respectively. These statistical tests results suggest that improvement in income per capita, access to sanitation facilities and undertaking primary educations have got strong effect in improving the health status of the region.

Furthermore, the estimator gives -0.143 as a coefficient estimate of RULA and this estimate is statistically significant, $p=0.001$, suggesting in the region strengthening rule of law has got a strong favorable effect in the attempt made to improve health status of SSA. Similarly, the estimator gives -0.07 as a coefficient estimate of GOEF, which is weakly significant, $p=0.063$, suggesting again in the region improving government effectiveness has got some rewards in terms of improve health status of SSA.

A look at Model-III, the estimation results conveys more or less similar messages. Table 9 indicates the Arellano-Bond test for AR(2) in the first difference accepts the null hypothesis of no serial correlation in the idiosyncratic errors, which implies that the instrumental variables are acceptable, $z = -1.012$ $\Pr > z = 0.312$. Besides, the table informs that for the panel economies under consideration the Wald test rejects the null hypothesis that states all the coefficients except the constant term are zero, $\chi^2(9)=527.13$ $\text{Prob} > \chi^2 = 0.000$.

Just like the case of Model-II, the table reports that the coefficient of the lagged dependent variable is statistically significant, 0.465 $z = 3.300$ $\Pr > z = 0.001$, confirming the need for controlling for previous level of IMR in the estimation process of estimating the coefficient of LNDAHE. Furthermore, the estimator gives -1.973 as the coefficient estimate of log-DAHE, which is strongly significant, $z = -4.31$ $\Pr > z = 0.000$, implying, just like the case of Model-II, that DAHE has a strong

negative effect on IMR. The estimate indicates that during the covered period of study, in the region, a 1% increase in DAHE, which is far less than 10 cents per capita at the mean level, saves the life of two infants per 1000 live births. This estimation result, again, strongly supports the view that in SSA health development assistance has a strong effect in improving health status of the population.

On the other hand, the table indicates that the log-GDPP coefficient estimate is -9.96, which is significant at 10 % level of significance, $z = -1.66$ $Pr > z = 0.098$, suggesting that raising per capita income growth contributes to the improvement of health status. In explicit terms, during 2001-2010, the IMR in SSA was 72 and per capita GDP growth was 2.0%. Keeping others unchanged; if in the subsequent periods the region managed to raise the rate of growth to 3% this would cause IMR to fall to 62 infants per 1000 live births.

In the same way the estimator gives -19.18 as a coefficient estimate of LNIMSF, which again is statistically significant, $z = -19.18$ $Pr > z = 0.005$. This estimation result implies that a 1% increase in access to improved sanitation facilities saves the life of 19 infants per 1000 live births, confirming the strong impact that raising access to sanitation facilities has in enhancing health status of the region. However, even if growth in IMSF has an impressive desirable effect on IMR, during the covered period of study IMSF was exhibiting declining rate, which may be due to rising population.

In such circumstance leave alone raising its growth, keeping it from declining could be a hard task for the countries of the region. Nevertheless, should they be able to be in a position of raising the growth rate of this variable by 1% they could reduce the regions IMR from 72, which was observed during 2001-2010, to 53 per 1000 live births. The table also provides strong empirical evidence in support of the view that primary education has remarkable role in developing health status. The estimation result indicates that a 1% increase in primary years of schooling could save the life of 32 infants per 1000 live births. The estimate is statistically significant, $z = -3.12$ $Pr > z = 0.002$.

Just like the case of Model-II the estimation results of Model-III presented in Table 9 indicates that rule of law and government effectiveness indices have negative and statistically significant coefficient estimates. This result points out the fact that in the region of study good governance plays an impressive role in the endeavors made to improve health status.

The next issue is to point out which model (from Model-II and Model-III) fits better to the data of the region. From the results of Table 9, it is not so easy to indicate the preferable type. However, one can approach the question from different angle. The correlation presented at the bottom of Table 9 indicates that both models have more or less similar correlation between their predicted IMR and actual IMR. Nevertheless, that of Model-III is slightly greater. The other alternative is to look at graphs of actual IMR and the predicted IMR of the two models. Figure 6, presents the graph of local polynomial smoothed line for actual IMR, predicted IMR from Model-II and predicted IMR from model-III for the covered period of study, 1990-2010.

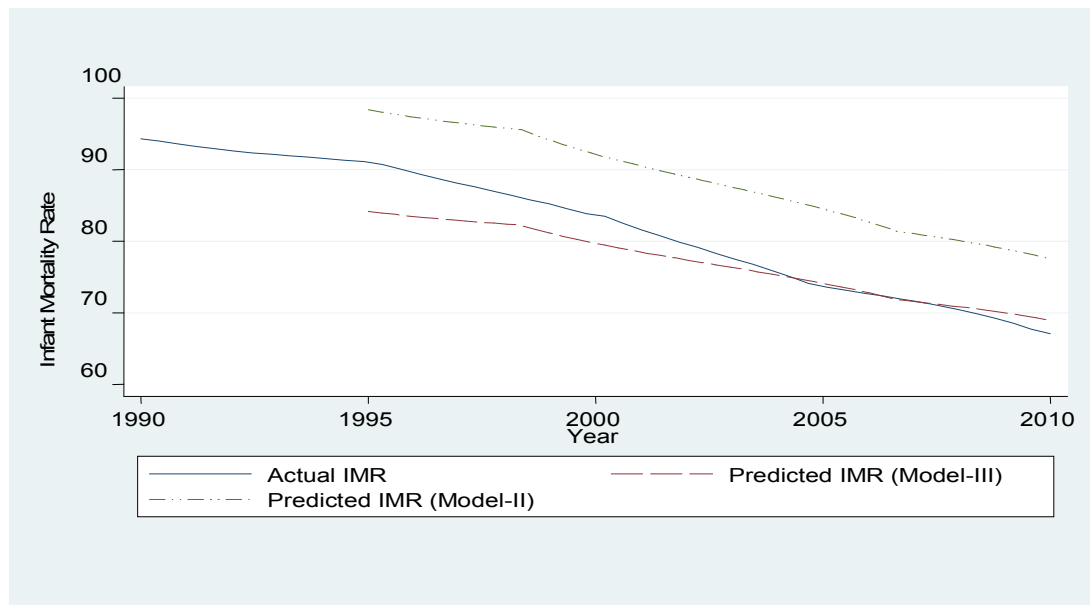


Figure 6. Local polynomial smoothed line for IMR, SSA (1990-2010)

The Figure indicates that both the actual and the predicted IMR were high above 80 per 1000 live births in early 1990s and exhibited declining trend then after. Even if both models follow more or less the pattern that actual IMR tracked, the predicted IMR from model-III is closer to the actual in level terms. Thus here again the less common (semi-log)-model-III seems to fit the data better than the more common (log-linear)-model-II (Figure 6).

6. Discussion

The first objective of this study is to describe patterns and document historical development of development assistance to health sector in Ethiopia. Using a retrospective period of 36 sampled years of observation, from the year 1978 to 2013, the study presented trends in DAHE in Ethiopia. The year 1978, as an initial period of the study is considered for the fact that there is a dearth of complete and comprehensive data prior to this period. However, it seems a reasonable initial period of time for the study as it was the historical landmark of the global “Health for ALL by the year 2000” through PHC strategies, particularly in developing countries like Ethiopia, tailored to a strong international collaborations in funding the PHC program(13). Thus, it provides a better insight to examine the relationship between donor’s contribution and the intended change of health outcome in the targeted country during the time-period from 1978 to 2000.

Consequently, the motto of PHC continued beyond 2000 through the Global campaign of UN summit of MDGs by 2015 with three out of the eight goals (goal 4,5,and 6) directly focusing on health status improvement. Thus, implementation of MDGs, from the year 2000 to 2015 resulted in a massive inflow of DAH to the developing countries in general and SSA in particular including Ethiopia. At the same time, during the MDGs implementation period, Ethiopia is among the SSA country with the highest in flow of DAH (89, 90).

Besides, the study considered the year 2013 as the last period of the study, because, it was the last recent, comprehensive data found from the common reliable sources during data collection. Nevertheless, the year 2013 is the year short before the end of MDGs implementation year (2015). Consequently, the time-period from 2000-2013 enables to capture the surge in DAH since the enactment of the MDGs, allows better opportunity to examine the effect of the DAH outpouring into the health sector of SSA in general and Ethiopia in particular.

Accordingly, the trend in DAHE per capita in Ethiopia during the period from 1978 up to the early 1990s is very small, less than 0.5 USD, may be due to the then communist regime’s closed economic policy to the outer world that might have limited the support of the western world(91). A more comprehensive report of DAHE was found after the year 1995 that might have also been an attribute

of the low trend observed in the year before the mid-1990s. DAHE, after slight progress, at about 1.00 USD per capita throughout the 1990s, a short decline around 2000 is observed, that might have been an attribute of the Ethio-Eritrean war of the 1998-2000 (91).

However, short after 2000, DAH has shown a steady increase throughout the 2012 but around 2010. This might be a result of global financiers' response to the MDGs implementation. A short decline is noted around 2010 which might be due to the global financial crisis of the 2008, since the current year expenditure report originates from the preceding years of disbarments (92).

As can be noted from the result of this study, the increasing trend noted from the year 2000 onwards might be an attribute of the high inflow of DAHE owing to MDGs implementation that has been accompanied by international financial support (23). In general the mean (SD) of DAHE during the study period (1978-2013) is 1.73(2.61), the minimum being 0.05, and the maximum 9.06. The overall descriptive pattern of DAH in Ethiopia during the study period has increased overtime, however. It would have been more reasonable to compare this figure with other similar SSA countries, however due to limitation of information for other similar countries for the aforementioned period of year is very limited, that could not be made.

In consideration with the historical emergence of development assistance for health sector in Ethiopia, the study attempted to shade light on the historical link of foreigners support to the emergence of modern medical care in the country though literatures pertaining to this are very limited. In the study it is highlighted that the first institution based health care in the country was initiated by foreigners support in the late 18th century, a Russian red cross mission who came to help the wounded soldiers in the late Ethio-Italian war (1).

Further, the study described the link of the country's successive history of modern health care development with the foreigners support (travelers, diplomatic or faith-based missions). In this regard, of note is the contribution of the American Presbyterian missionary man, Dr. Thomas Lambie. His contribution was noticed in the 1922 establishment of the then Gulale Hospital (George Memorial Hospital) later on named Pasteur institute with the collaboration of another foreign support from France (1-4).

While it is very difficult to get the quantitative data of such historical supports by foreigners, say in-kind and in financial terms, it well informs the role of the foreigners' support in the historical development of institutional based modern health care provision in the country.

Moreover, it helps to have a reasonable assumption that the historical contributions of foreigners is of a paramount in progressing the Ethiopian health care delivery status by providing preventive, curative and rehabilitative care to the population. At the same time, the officially documented data of the successive years termed as “external fund” witnesses contribution of foreigner's to the country's health development. For example, there are officially documented budget data in late 1970s, 1980s, and early 1990s that indicate external assistance for public health development(64, 69), and in which the data were considered for further analysis in current study.

It has been pointed out that Ethiopia has been received technical assistance from WHO, UNICEF, USAID, and other countries in the establishment of the Public Health School, Medical School, Nursing School and a number of hospitals, as well as the provision of technical assistance to the Ministry of Health in 1950s(8-11).

Though inconclusive from the history, it is likely that the aforementioned contribution of foreign support seems to be an evident input for the development of population health in the country.

As noted above, Ethiopia's health sector has been largely an externally supported sector long in history and more so in recent years as evidenced by an increased amount of DAH(18). Thus, the consideration of an evidence-based effect of DAH on health outcome in the country is reasonable.

Hence, the second objective of this study is to investigate the effect of development assistance on health status in Ethiopia.

Therefore, in consideration of country specific analysis of DAH's effect on health status, the study considered DAHE as a main explanatory variable and LEB as an indicator of health status outcome for its long been used as a measure of health status in the literatures, for instance, as a human development index (93).

Since health is an outcome of multiple factors like socio-economic, demographic and environmental factors(62-64, 83), for this specific study; GDP, the rest of public health expenditure, female educational level and population aged between 15 and 64 were included as a control variables depending up on the availability of comprehensive and complete data for the selected health related variables.

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 ($P=0.000$) 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(94) that reports change of LEB to DAH as 0.02 month. Bendavid& Bhattacharya studied on 140 aid-recipient countries between 1974 and 2010. 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 (89). 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 implemented by deployment of high number of health extension workers and this might have been an account for the significant effect and difference observed in the current study (38, 90).

Similarly, the elasticity estimates of the current result is slightly higher than the country specific study conducted in Pakistan, that reported 0.024 (95) 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 (33, 35).

In consideration of the effect of the rest of public health expenditure on health status in the country, the study revealed that there is a positive and significant relationship between the two variables. 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. 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(89). 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, GDP per capita has got a positive significant effect on LEB and this finding is consistent with results reported elsewhere(61, 63). 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. While female's education is considered an important determinant of health status, in this study it shows unexpected sign though not significant, this might be due to the nature of variable considered, that gross enrolment was considered instead of years of schooling or net enrollment ratios due to limitation of country specific data.

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 (89).

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 country level 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 (18).

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 (72) 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 were 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.

In considering, the findings from the regional specific study of DAH effect on health outcomes in SSA, three alternative models (Model I, Model II, and Model III) in the theoretical framework and imposed sequentially, and the superior model (Model III) was considered in reporting the results. Even if very common types in empirical researches is Model I and Model II (63, 64), both presume the possibility of sustained improvements in health status. To explain more the three imposed model equations as an alternative, the first IMR estimating equation (Model I) assumes that the present level

of IMR is determined solely by the present level of explanatory variables. It assumes absence of lagged effects of explanatory variables as well as lagged effect of IMR itself. This assumption, even if it is quite common in empirical works, is over-simplification as the real situation involves lagged effects. Besides this, the equation assumes the stability of elasticity of IMR with respect to explanatory variables. In this case, again even if the assumption is very common it has no well-established explanation for the mechanism that ensures the assumed stability.

The second IMR estimating equation (Model II) is based on the assumption that present IMR depends partly on the previous level of IMR or lagged IMR which after some mathematical manipulations could mean; besides the present level of explanatory variables all, the past levels of explanatory variables have some influence on the present level of IMR, where their degree of influence decay with time. Moreover, this equation assumes stability of IMR elasticity with respect to explanatory variables. The equation was estimated using first difference generalized methods of moments. The estimation results obtained from this estimator was reported as a competing results with the third IMR estimating equation.

The third IMR estimating equation (Model III) assumes the presence of lagged effects but drops the assumption of stability of IMR elasticity with respect to explanatory variables. Instead, it assumes stability of the product of the elasticities and IMR. That is it considers rising elasticities, in absolute terms, as IMR falls with time. In this case again, first difference-generalized methods of moments was employed for estimating IMR equation.

Two approaches were made in deciding the superiority of these competing models (Model II and Model III). First, the correlation between their predicted IMR and actual IMR was measured, in which Model-III exhibits greater correlation than Model II though small. The other alternative used is by looking at graphs of actual IMR and the predicted IMR of the two models. Even if both models follow more or less the pattern that actual IMR tracked, the predicted IMR from model-III is found to be closer to the actual in level terms. Therefore, the semi-log -model-III seems to fit the data better than the more common (log-linear)-model-II. Therefore, this study emphasizes Model III for the presented report.

Accordingly, DAHE is found to have a strong negative effect on the reduction of IMR. The estimate indicates that during the covered period of study, in the region, a 1% increase in DAHE, which is far less than 10 cents per capita at the mean level, saves the life of two infants per 1000 live births. This is consistent with the study of Mishra & Newhouse (20) and the estimation result similar to the country level finding strongly supports the view that in SSA health development assistance has a strong effect in improving health status of the population.

In general, this study provides consistent evidence supporting the argument that DAH has played a role in health improvements, evidencing the links between the observed health improvements and the DAH over the past two to three decades.

While this finding only provides suggestive effect of DAH on health status, it is worth mentioning PHC as the potential drivers of this effect. Because throughout the study period in Ethiopia and in SSA, PHC as a strategy is in place and its effectiveness was documented in Ethiopia and elsewhere (9, 90). Therefore, the PHC strategies in general and specific communicable diseases that were targeted at the early decades like malaria in particular, are the possible ways that the DAHE might have been resulted in improvements of health in Ethiopia, and in SSA in general.

During the sampled period of this study period, of note is, the emergence of global pandemic diseases specially HIV/AIDS that has drawn special attention of international collaborators in fighting the disease. It has been reported that the reason for increased amount of DAH during the last two period is in part an attribute of this disease (16, 23). Therefore, targeting the disease has an increasing return to DAH by increasing the life expectancy of the population.

More recently, over the last two decades, antiretroviral therapy, insecticide-treated bed nets, and the expansion of directly observed treatment short course (DOTS) for tuberculosis have been a mainstays of aid-financed interventions through which the progress in increased life expectancy might have been achieved (94).

7. Validity and Generalizability

In consideration of validity of the study, first, the statistical conclusions in this study followed a thorough step without violation of assumptions in the consecutive steps. Hence, the statistical conclusion of validity is maintained. Besides, the findings of the study are also consistent with the available literatures.

In addition, the study generally used indicators that are already recognized by national and international organizations for data collection, meaning that the instrument possesses a pre-established degree of validity and reliability that need not be re-examined by the investigator.

In terms of representativeness, the study considered the entire country and region of SSA hence, is reasonable to give a conclusion referring both samples to be representative. At the same time, the sampled years for the specific country, and SSA level are also acceptable as outlined earlier in methodology and discussion sections.

8. Strengths and Limitations

Many features can distinguish the current study. First, in contrast with the available scarce literatures on this matter, the study presented both country-level evidence- using time series analysis, and regional level evidence- using panel (time series cross-sectional) analysis, unlike previous studies that relied only either on time series or cross country studies.

Second, this study is the first macro level study that considered the actual amount of health expenditures data sourced from external assistance in the recipient countries.

Third, it is among few macro level studies that attempted to utilize econometric technique in public health discipline in Ethiopia, thus the study will be among the rare studies that can potentially activate such areas for future research.

Fourth, the study has attempted to generate theoretical framework by augmenting the previous theoretical approaches.

The study is limited however, in the sense that the variables used for proxy determinants of health outcome may not be exhaustive due to data limitation; other socio economic, medical, life style and environmental variables may be correlated with health outcome. Besides, DAHE data suffer under-reporting particularly the national level data prior to 1995 in that it only captured the on line budget-expenditure data and aid from non-governmental organizations was not captured. Therefore, the estimates are likely to underestimate the true effect of DAH on health status in Ethiopia. Structural difference of the included two regimes in the Ethiopia country context study might have imposed its own limitation. In addition, use of secondary data has also its own limitations, as one would expect.

While these limitations may be the bases for future research, they do not invalidate the results of the current study.

9. Conclusions

The study sought to determine the effect of DAH on health status as measured by life expectancy at birth in Ethiopia, and infant mortality rate in SSA.

The results shows that DAH is associated with increased life expectancy at birth in Ethiopia. The results also indicates that local funding as a source of health expenditure and income are significantly associated with improved health outcomes, in the country. The findings imply that, DAH, local fund for health care expenditures and improving income are essential components to improve health status in Ethiopia.

In the econometric analysis of SSA, per capita health development assistance, per capita income, primary years of schooling, improved sanitation facilities, control of corruption index, rule of law index, regulatory quality index and government effectiveness index were used as explanatory variables. The obtained result indicates that rule of law and government effectiveness have negative and statistically significant coefficient, suggesting strengthening these two variables could serve as a useful measure in reducing IMR of the region.

Besides this, the estimation results suggested that increase in per capita GDP, strengthening participation in primary level education and provision of improved sanitation facilities have strong effect in reducing IMR.

Concerning the variable of interest, DAHE, the estimator gave negative and statistically significant coefficient estimate. It indicates that a 1% increase in per capita DAHE growth would result in saving the life of 2 infants per 1000 live births.

Contrary to DAH pessimists view, this study observes the fact that health development assistance has strong favorable effect in improving health status of people in SSA in general and Ethiopia in particular.

Therefore, the investigator believes that these findings add up evidence on the scanty literature that found a statistically significant and positive degree of interplay between health-targeted aid and

health outcomes in recipient countries. However, even if positive impact of health targeted aid is evidenced, SSA countries need to find ways of promoting domestic factors that have favorable impact on the health sector, as they cannot rely up on external resource persistently to improve health status of the population.

10. Recommendations

Based up on the findings of this study, it is recommended that:

- Development assistance for health sector should continue in SSA focusing on PHC as it has been doing. In addition to the current strategy of PHC that assumes health care providers (the health care facilities like district hospitals, health centers, health posts...) providing services to the population, DAH stakeholders should also think of parallel strategies in targeting improving socio economic status, particularly GDP that help the population to produce health and maintain sustainability;
- The study also informs that Countries in SSA need to find ways of promoting domestic factors that have favorable impact on the health sector, as they cannot rely upon external resources continuously. In this regard, sustainable national alternative health financing system that substitute the DAHE, for example, social and community based insurance, should be prioritized and implemented aggressively;
- Finally, though the current study findings are consistent with the hypothesis that DAH has been an important driver of health improvements in SSA in general and Ethiopia in particular, possibilities of using alternative methodological approaches, that address the aforementioned limitation deserve considerations for future studies on the subject.

11. Acknowledgements

Glory be to the Almighty God for His abundant love, grace and mercies throughout my academic life and particularly during the period of this thesis.

I would like to express my deepest appreciation and gratitude to Prof. Damen Haile Mariam for his tremendous tutelage, constructive criticisms, suggestions and corrections throughout this thesis work. Prof. Damen has not only improved my way of analyzing the things in real life but also help me to think critically from various angles that were unexplored and untouched by me. His patience and care while I was struggling to overcome the social challenge I encountered during my thesis work is always at the deepest of my heart. I feel extremely lucky and humbled to have had the opportunity to learn from him.

I believe I would never have completed this work and gotten this far without the support of my parents (father, mother, brothers and sisters). I am sure that a simple thank you will never be enough to convey my gratitude.

I am grateful to AAU School of public health for providing me an opportunity for the study and patience the school shown to me. Their understanding of the social challenge I encountered during my thesis work has tremendously helped me to come up with this final work of my thesis. The University also deserves my acknowledgements for enabling me conduct this thesis financially.

I would like to extend my gratitude to WB, WHO, CSA, MoFEC and FMOH for availing all the necessary data for this study publically.

12. References

1. Mehari E, Gebeyehu K, Asfaw Z. The Manual of Ethiopian Medical History; A publication of people to people: People to People, Inc; 2013.
2. EPHI. History of EPHI Addis Ababa, Ethiopia: EPHI; 2016 [cited 2016 May 29]. Available from: <http://www.ephi.gov.et/index.php/2014-04-09-13-52-44/2014-04-09-13-53-29/history-of-ephi>.
3. Kebede A. Central role of the Ethiopian Public Health Institute. Ye Science Admas, A Biannually Published Scientific Newsletter of the Ethiopian Public Health Institute. 2014 August 2014.
4. Wikipedia contributors. Bibliographic details for Thomas Lambie: Wikipedia, The Free Encyclopedia.; 2016 [cited 2016 June 15]. Available from: https://en.wikipedia.org/w/index.php?title=Thomas_Lambie&oldid=712462780.
5. Kitaw Y, Tekla G-E, Meche H. Lessons from the evolution of human resources for health in Ethiopia: 1941-2010. Ethiop J Health De. 2013;27(Special Issue 1).
6. Ali A. The History of Nursing in Ethiopia. Nursing History Review. 2011;19:158–60.
7. Tilahun YG, Nasrabadi A, Alemayehu M, Teklu AM, Charania NAMA. The journey of Ethiopian nursing education: a glimpse of past, present and future. International Journal of Current Research. 2016;8(2):26828-33.
8. Lindgren AM. End-of-Tour report. U.S. Dept. AID/Washington, 1966 Contract No.: Reference centre Room 1656 NS.
9. Kloos H. Primary health care in Ethiopia under three political systems: Community participation in a war-torn society. Soc Sci Med. 1998;46(4-5): 505-22.
10. Swindall HS, Burt ML. A Beginning in Ethiopia. The American Journal of Nursing. 1961;61(5):82-4.
11. Torrey EF. Health Services in Ethiopia. The Milbank Memorial Fund Quarterly. 1967;45(3):275-85.

12. Nations U. Sweden and Ethiopia Agreement for technical assistance in the field of Health 1958 [cited 2016 June 6]. Available from: <http://www.ifrc.org/docs/idrl/I66EN.pdf>.
13. WHO. Declaration of Alma-Ata. International Conference on Primary Health Care Alma-Ata, USSR1978 [cited 2016 May 30]. Available from: http://www.who.int/publications/almaata_declaration_en.pdf
14. Nation U. United Nations Millennium Declaration 2000 [cited 2016 May 30]. Available from: <http://www.un.org/millennium/declaration/ares552e.pdf>.
15. WHO. Aid effectiveness and health. WHO/HSS/healthsystems2007.
16. Graves CM, Haakenstad A, Dieleman JL. Tracking development assistance for health to fragile states: 2005–2011. *Globalization and Health* 2015; 11(12):DOI 10.1186/s12992-015-0097-9.
17. Ravishankar N, Gubbins P, Cooley RJ, Leach-Kemon K, Michaud CM, Jamison DT, et al. Financing of global health: tracking development assistance for health from 1990 to 2007. *The Lancet*. 2009;373:2113–24.
18. Health FDRoEMo. ETHIOPIA’S FIFTH NATIONAL HEALTH ACCOUNTS, 2010/2011. Addis Ababa,Ethiopia2014.
19. Ejughemre U. Donor Support and the Impacts on Health System Strengthening in Sub-Saharan Africa: Assessing the Evidence through a Review of the Literature. . *American Journal of Public Health Research*. 2013;1(7):146-51.
20. Mishra P, Newhouse D. Does Health Aid Matter? *Journal of Health Economics*. 2009;28:855-72.
21. Gottret P, Schieber G. *Health Financing Revisited, A Practioner’s Guide*. 1818 H Street NW,Washington DC 20433: The World Bank; 2006.
22. WHO. *Global health expenditure Atlas*. Geneva, Switzerland: WHO press 2014.
23. Dieleman JL, Graves C, Johnson E, Templin T, Birger M, Hamavid H, et al. Sources and Focus of Health Development Assistance,1990–2014. *JAMA*. 2015;313(23):2359-68.

24. Alemu G. A Case study on aid effectiveness in ethiopia,analysis of the health sector aid architecture: Wolfensohn center for development; 2009 [cited 2016 June 5]. Working Paper 9]. Available from: http://www.brookings.edu/~media/research/files/papers/2009/4/ethiopia-aid-alemu/04_ethiopia_aid_alemu.pdf.
25. ECA. Assessing Progress in Africa toward the Millennium Development Goals. . Addis Ababa, Ethiopia: United Nations Economic Commission for Africa 2015.
26. Federal Democratic Republic of Ethiopia Ministry of Health. Policy and practice information for action. Quarterly Health Bulletin. Addis Ababa2014. p. 3-4.
27. Central Statistical Authority [Ethiopia], Macro O. Ethiopia Demographic and Health Survey 2000. Addis Ababa, Ethiopia and Calverton, Maryland, USA2001.
28. Central Statistical Agency [Ethiopia], Macro aO. Ethiopia Demographic and Health Survey 2005. Addis Ababa, Ethiopia and Calverton, Maryland, USA2006.
29. Central Statistical Agency [Ethiopia], International aI. Ethiopia Demographic and Health Survey 2011. . Addis Ababa, Ethiopia and Calverton, Maryland, USA2012.
30. Drabo A, Ebeke CH. Remittances, Public Health Spending and Foreign Aid in the Access to Health Care Services in Developing Countries. CERDI, Etudes et Documents, 2011.
31. Chauvet L, Gubert F, Mesplé-Somps S. Aid, Remittances, Medical Brain Drain and Child Mortality: Evidence Using Inter and Intra-Country Data. Journal of Development Studies. 2013; (49):801-18.
32. Gomanee K, Girma S, Morrissey O. Aid, public spending and human welfare: evidence from quantile regressions. Journal of International Development. 2005(17):299-309.
33. Williamson CR. Foreign Aid and Human Development: The Impact of Foreign Aid to the Health Sector. Southern Economic Journal 2008;75 (1):188-207.

34. Kosack S, Tobin J. Funding self-sustaining development: The role of aid, FDI and government in economic success. *International organization*. 2006;60(1):205–43.
35. WILSON SE. Chasing Success: Health Sector Aid and Mortality. *World Development* 2011;39(11):2032–43.
36. World Bank. Ethiopian. Ethiopian Overview 2016 [cited 2016 May 31]. Available from: <http://www.worldbank.org/en/country/ethiopia/overview>.
37. WHO. Ethiopia country context 2015 [cited 2015 May 30]. Available from: http://www.who.int/profiles_information/index.php/Ethiopia.
38. The Federal Democratic Republic of Ethiopia, Ministry of Health. Health sector transformation plan 2015/16 - 2019/20. Addis Ababa, Ethiopia 2015.
39. World Health Organization. World health Statistics 2015 June 1, 2016. Available from: [who.int/iris/bitstream/10665/170250/1/9789240694439_eng.pdf](http://www.who.int/iris/bitstream/10665/170250/1/9789240694439_eng.pdf)
40. World health organization, Ethiopia. WHO statistical profile 2015 [cited 2016 June 6]. Available from: <http://www.who.int/gho/countries/eth.pdf>.
41. World Development Indicators [Internet]. World Bank 2015 [cited March 17 (last accessed)]. Available from: <http://data.worldbank.org/data-catalog/world-development-indicators>.
42. World Development Indicators, Ethiopia. [Internet]. 2015 [cited April 19, last accessed]. Available from: http://data.worldbank.org/country/ethiopia#cp_wdi.
43. Maele NVd, Evans DB, Tan-Torres T. Development assistance for health in Africa: are we telling the right story? *Bull World Health Organ* 2013(91):483–90.
44. United Nations. United Nations Sustainable Development Goals 2015 [cited 2016 May 30]. Available from: <https://un.org/post2015/transformingourworld>

45. Wikipedia contributors. Marshal Plan 2016 [cited 2016 May 31]. Available from: https://en.wikipedia.org/wiki/Development_aid.
46. SACHS JD. The End of Poverty: Economic Possibilities for Our Time. NEW YORK The Penguin press, 2005. Available from: http://www.economia.unam.mx/cedrus/descargas/jeffrey_sachs_the_end_of_poverty_economic_possibilities_for_our_time__2006.pdf.
47. Sachs DJ, McArthur JW, Schmidt-Traub G, et al. Ending Africa's poverty trap. Brookings papers on economic activity [Internet]. 2004 June 13:[117–240 pp.].
48. Easterly W. The White Man's Burden: Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good: THE PENGUIN PRESS; 2006 [cited 2013 June 13]. Available from: <https://www.gordon.edu/ace/pdf/Spr07BRSchaffner.pdf>.
49. Eastery W. Can foreign aid buy growth? . The Journal of Economic Perspectives. .2003;17(3):23-48.
50. Easterly W. Can the West Save Africa. Journal of Economic Literature. 2009;47:373–447.
51. Moyo D. Dead aid: Why aid is not working and how there is a better way for Africa. Farrar, Straus and Giroux, New York; 2009. New York: Farrar, Straus and Giroux; 2009.
52. Atim, Chris, Lisa K, Fleisher, Hatt L, Musau S, et al. Health Financing in Africa Today: Challenges and Opportunities. Washington, DC: Abt Associates Inc; 2008.
53. Alvarez MM, Acharya A. Aid Effectiveness in the Health Sector. [Working Paper]. In press 2012.
54. Juselius K, Møller FN, Tarp F. The Long-Run Impact of Foreign Aid in 36 African Countries: Insights from Multivariate Time Series Analysis. Oxford Bulletin of Economics and Statistics. 2014;76(2):0305-9049.

55. Paul C DD. Aid allocation and poverty reduction. *European Economic Review*. 2002(46): 1475-500.
56. Paul M, Suleiman A. Aid, agriculture, and poverty in developing countries. *Review of Development Economics*. 2007;11(1):139-58.
57. Levine R. Millions Saved: Proven Successes in Global Health. In: Kinder, M.(ed.) *What Works Working Group*. 2004.
58. Johansen S. Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*. 1988(12):231-25
59. Hogg VR, Tanis AE, . *Probability and Statistical Inference*. NJ: Pearson Education Inc; 2010.
60. Global health expenditure [Internet]. 2015 [cited June 3,2016 (last accessed)]. Available from: <http://apps.who.int/nha/database>.
61. Aisa R, Clemente J, Pueyo F. The influence of (public) health expenditure on longevity. *International Journal of Public Health* 2014(59):867–75.
62. Navignon J OS, and Nonvignon J,. The effects of public and private health care expenditure on health status in sub-Saharan Africa: new evidence from panel data analysis. *Health Economics Review* 2012;2(22):1-8.
63. Filmer D PL. The impact of public spending on health: Does money matter? . *Social Science and Medicine*. 1999(49):1309–23.
64. Akinkugbe O MM. Public Health Expenditure as a Determinant of Health Status in Lesotho. *Social Work in Public Health*. 2009(24):131–47.
65. Central Statistics Agency, Federal Democratic Republic of Ethiopia. *Statistical abstracts*. Addis Ababa,Ethiopia: CSA; 1978. p. 158-60.
66. Central Statistics Agency, Federal Democratic Republic of Ethiopia. *Statistical abstracts*. Addis Ababa,Ethiopia: CSA; 1980. p. 189.

67. Central Statistics Agency, Federal Democratic Republic of Ethiopia. Statistical abstracts. Addis Ababa,Ethiopia: CSA; 1990. p. 196-7.
68. Central Statistics Agency, Federal Democratic Republic of Ethiopia. Statistical abstracts. Addis Ababa,Ethiopia: CSA; 1992. p. 208.
69. Central Statistics Agency, Federal Democratic Republic of Ethiopia. Statistical abstracts, . Addis Ababa,Ethiopia: CSA; 1995. p. .235.
70. Ministry of Finance. Tubular profile of Ethiopia public revenue and Expenditure 1949/50-1991/1992, revised Ministry of Finance Planning and research department,; 1995. p. 7-14.
71. Ministry of Finance. Central Government revenue, Capital expenditure by source, foreign assistance, 1965/66-1988/89. Addis Ababa,Ethiopia: MOFED. p. 19.
72. Ministry of Health, Ethiopia FDRo. Health & Health Related Indicators, 1998-2005 Addis Ababa,Ethiopia.
73. African Development Indicators [Internet]. 2015 [cited April 19, 2016]. Available from: <http://data.worldbank.org/data-catalog/africa-development-indicators>.
74. Barro R, J.W. L. A New Data Set of Educational Attainment in the World, 1950-2010. Journal of Development Economics, 2010; (104):184-98.
75. Worldwide Governance Indicators [Internet]. 2013 [cited 5 March 2013]. Available from: <http://data.worldbank.org/data-catalog/worldwide-governance-indicators>[Accessed
76. Granger JWC, Newbold P. Spurious regressions in econometrics. Journal of Econometrics. 1974(2):111-20.
77. Engle RF, Granger CW. Co-integration and error correction: representation, estimation and testing. Econometrica. 1987;55(2):251–76.
78. Dickey DA, WA. F. Likelihood ratios for autoregressive time series. Econometrica. 1981(49):1057–172.

79. Phillips PCB , Perron P. Testing for Unit Roots in Time Series Regression. *Biometrika*. 1988;75 (2):335–46.
80. Bera A, Jarque C. Efficient Tests for Normality, Heteroskedasticity, and Serial Independence of Regression Residuals: Monte Carlo Evidence. *Economics Letters* 1981(7):313–8.
81. Gujarati DN. *Basic Econometrics* The McGraw–Hill Companies; 2004.
82. Wooldridge JM. *Introductory Econometrics: A Modern Approach*. 2nd ed: South-Western Publisher; 2002.
83. Grossman M. On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy*. 1972(80):223-55.
84. Blundell R, Bond S. GMM estimation with persistent panel data, an application to production functions. *Econometric Reviews*. 2000(19):321–40.
85. Arellano M, Bond S. Some tests for panel data: Monte Carlo evidence and an application to an employment equation. *The Review of Economic Studies*. 1991;58(58):277-97.
86. Alonso-Borrego, Arellano M. Symmetrically normalized instrumental variable estimation using panel data. [CEMFI Working Paper No.9612]. In press 1996.
87. Grépin KA, Kemon KL, Schneider M, Sridhar D. How to do (or not to do). Tracking data on development assistance for health. . *Health Policy Plan*. 2012(6)::527–34.
88. Vassall A, Shotton J, Reshetnyk KO, et al. Tracking aid flows for development assistance for health. *Glob Health Action* [Internet]. 1014 March 6 2016; (7):[23510 - pp.]. Available from: <http://dx.doi.org/10.3402/gha.v7.23510>
89. Ssozy J AS. The Effectiveness of Health Expenditure on the Proximate and Ultimate Goals of Healthcare in Sub-Saharan Africa. *World Development* 2015(76):165-79.
90. Shaw PR WH, Kress D, Hovig D, . Donor and Domestic Financing of Primary Health Care in Low Income Countries. *Health Systems & Reform*. 2015;1(1):72-8.

91. Wikipedia contributors. Foreign aid to Ethiopia. In Wikipedia. The Free Encyclopedia. 2014 [cited 2016 June 17]. Available from: https://en.wikipedia.org/w/index.php?title=Foreign_aid_to_Ethiopia&oldid=623989114
92. International Monetary Fund. Impact of the Global Financial Crisis on Sub-Saharan Africa, African department: MF Multimedia Services Division; 2009 [cited 2016 June 17]. Available from: <https://www.imf.org/external/pubs/ft/books/2009/afrglobfin/ssaglobalfin.pdf>.
93. Wikipedia contributors. Human Development Index The Free Encyclopedia. Available: 2016 [cited 2016 June 16]. Available from: https://en.wikipedia.org/w/index.php?title=Human_Development_Index&oldid=725604668.
94. Bendavid E, Bhattacharya J. The Relationship of Health Aid to Population Health Improvements. JAMA Intern Med 2014 ; 174(6): 881–887. 2014;174(6):881-7.
95. Anwar S, Rana AM, Nasreen S. Evaluation of the Contribution of Public Health Expenditure on Health in Pakistan: A Time- Series Analysis. The Empirical Economics Letters. 2012;11(10).

13. Appendices

Appendix I: Detail derivation of Equation 4.

To observe the fact that equation (4) captures the lagged effects of explanatory variables on the dependant variable as well, one may lag the dependant variable by one period and substitute the expression on the right hand side in equation (4). Repeating the same action by lagging the dependant by two, three, periods and so on and substituting the results in the original equation, the ultimate equation will be expression of dependant variable in terms of all the present and past values of the explanatory variables. That is from equation (4):

$$\ln Y(t) = \delta \ln Y(t-1) + \sum_{j=1}^n \varepsilon_j \ln X_j(t) + \alpha_2 \quad (4)$$

by lagging the equation by one period

$$\ln Y(t-1) = \mu + \beta_0 \ln Y(t-2) + \beta_1 \ln X_1(t-1) + \beta_2 \ln X_2(t-1) + \dots + \beta_n \ln X_n(t-1) + \alpha_2 \quad (4.a) \text{ Repeating}$$

the same action on equation (4.a) to get

$$\ln Y(t-2) = \mu + \beta_0 \ln Y(t-3) + \beta_1 \ln X_1(t-2) + \beta_2 \ln X_2(t-2) + \dots + \beta_n \ln X_n(t-2) + \alpha_2 \quad [4.b] \text{ and so}$$

on, and then substituting (4.b) in (3.a) and substituting (4.a) in [4], one gets general equation as

$$\begin{aligned} \ln Y(t) = & \mu + \beta_1 \ln X_1(t) + \beta_2 \ln X_2(t) + \dots + \beta_n \ln X_n(t) + \\ & \beta_0 [\mu + \beta_1 \ln X_1(t-1) + \beta_2 \ln X_2(t-1) + \dots + \beta_n \ln X_n(t-1)] + \\ & \beta_0^2 [\mu + \beta_1 \ln X_1(t-2) + \beta_2 \ln X_2(t-2) + \dots + \beta_n \ln X_n(t-2)] + \dots + \\ & \beta_0^m [\mu + \beta_1 \ln X_1(t-m) + \beta_2 \ln X_2(t-m) + \dots + \beta_n \ln X_n(t-m)] + \beta_0^m \ln Y(t-m) + \alpha_2 \end{aligned} \quad (4c)$$

Where m is the maximum possible lag in years. Equation (4.c) expresses present level of health status in terms of all the possible lags of explanatory variables. Moreover, the equation implies that the lagged effects of the explanatory variables decay with time as far as $0 < \beta_0 < 1$

Appendix II: Original Papers

Paper I

Paper II

Does health sector aid matter?

Evidence from Time series data analysis in Ethiopia

KeneniGutema Negeri¹, Damen Halemariam²

¹ Department of Public Health, Health Service Management Unit, College of Medicine and Health Sciences, Hawassa University, Hawassa, Ethiopia

²College of Medicine and Health Sciences, School of Public Health, Addis Ababa University, Addis Ababa, Ethiopia

Email address: kenenigut2000@yahoo.com

damengoog@gmail.com

Abstract

Background: Health targeted aid in the form of development assistance for health has been an important part of financing health sectors in developing countries in general and Ethiopia in particular. In spite of the increasing volumes of health targeted aid, there is an increasing controversy whether the scaled-up aid for the health is producing the intended health outcomes, and if so the extent to which the change is occurred. While Ethiopia is among the top health aid recipient countries, studies made on this issue are scarce. Therefore this study aims to analyze the effect of health sector targeted development aid on health status in Ethiopia.

Method: Using dynamic time series analytic approach, this paper examines the effect of development assistance for health sector on health status in Ethiopia for the period 1978-2013, with a sample of 36 year observation. life expectancy at birth is used as a measure of health status as it has long been used as a measure of health status. To analyze the effects of development assistance for health on the health status measure, an econometric technique - Vector Error Correction Model is applied for the advantage that it provide a valuable information on the long run and short run relationships of the variables under study.

Results: The result reveals that the immediate one and two prior year of development assistance for health expenditure has a significant positive effect on life expectancy at birth. Other things being equal, an increase of development assistance for health expenditure per capita by 1% leads to an improvement in life expectancy at birth by about 0.026 year ($P=0.000$) in the immediate year following the period, and 0.008 year following the immediate two years period ($P=0.025$).

Conclusion and recommendations : Contrary to skeptics, this study observes the fact that development assistance for health sector possesses a strong favorable effect in improving health status in Ethiopia. The policy implication of the current findings is, whilst, development assistance for the health sector should continue as an interim necessity means to an end, domestic health financing system like the health insurance already initiated in the country should be strengthened. At the same time, the current assumption of targeting facility based primary health care provision should be augmented by a more strong parallel strategy; household based- integrated primary health development package approach (nutrition, animal husbandry, education, promoting healthy-productive behavior) for a sustainable and more effective and efficient way of improving health status of the population.

Introduction

Despite the ample empirical research results we have in the literature considering the effect of foreign aid on economic growth, there is paucity of researches dealing with the effects of aid in the form of Development Assistance for health (DAH) on health outcomes. Within the available part of the literature itself, there is lack of agreement concerning effect of health aid in developing countries. Some writers argue that health specific aid leads to improved health outcomes in developing countries by relaxing resource constraints and directly improving health service delivery. In line of this thought, Levine (1) argue that health is an area where development assistance is likely to see positive changes because health activities such as prevention and control of communicable diseases through safe and adequate water supply, effective sanitation, immunizations, and better nutrition are directly related to the sought health outcomes. The empirical studies by Ebeke, and Drabo, and Mishra and Newhouse (2,3) also report a strong positive effect of health aid on health outcome in developing countries. Using donor commitments aid data from 118 recipient countries between 1973 and 2004 period, Mishra and Newhouse found that health aid has significant beneficial effect on IMR (2). Chauvet, Gubert and Mesple-Soms (4) who analyzed the respective impact of aid and remittances on infant and child mortality rates with a panel data of 109 developing countries from 1987 to 2004, also reported results that suggest health aid significantly improve health outcomes. According to these authors, the impact of health aid is non-linear that imply aid to the health sector is more effective in the poorest countries (4). In a similar vein, Gormanee, Girma and Morrissey who used quintile regression analysis, find that aggregate aid improves health status of developing countries, pointing that at a lower income level, the benefits of aid to human welfare are higher (5).

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

Although SSA in general and Ethiopia in particular are the biggest recipient of DAH (8) evidence on the relationship between DAHE and health status outcome in the region is very rare. The few available studies make use of a full sample of developing countries, though controlled for the region using regional dummies. Besides that most of the previous studies make use of DAH data on commitments (2,3,6) that may not necessarily be the actual amount of aid that the recipient country utilized for health . To get more refined result concerning the effect under consideration for the region, one need to investigate the case of the region separately using Development assistance for health expenditure data instead of the aid commitment and even disbursement data.

Ethiopia has been one of the major DAH recipient countries for decades, more so during the last two decades with the large and growing inflows following the country's inception of Health Sector Development Plan (HSDP) by Federal Ministry of Health (FMOH)(9).For instance, in the year between 2002 and 2007,the country is the second among the 30 countries of the world with greatest cumulative DAH recipient countries following India (8).Similarly,

in the year between 2009 and 2011, Ethiopia received the second highest volume of average DAH among the 24 low and lower-middle income countries, while in 2011 alone, the country received the most health aid of all DAH recipient countries.(10). Correspondingly, the National Health Account (NHA) report of Ethiopia shows that in the country, DAH from donors and international Non-Governmental Organizations(NGOs) covers 50% of general health care spending in the year 2010/2011, up from 40% in the year 2007/2008 (11).

Parallel to the progress of DAHE , evidences shows that health outcomes in the country has shown noticeable changes in 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 (reducing under five mortality rate) two years before the target year(11-13).

According to Ethiopia Demographic and Health Survey (EDHS) report of the year 2000, 2005 and 2011, there is a continuous declining trend in U5MR and IMR. U5MR decreased by 47 percent, from 166 deaths per 1,000 live births in the year 2000 survey to 88 in the year 2011, while IMR decreased by 39 percent, from 97 in the year 2000 survey to 59 in the year 2011 survey (14-16).

On the other hand, neonatal mortality rate decreased from 49 deaths per 1,000 live births in the year 2000 to 39 deaths per 1,000 live births in the year 2005, it has since remained stable at 37 deaths per 1,000, as reported in the 2011 EDHS. Similarly, the estimated maternal mortality ratio (MMR) is almost the same in the 2011 EDHS (676) as it was in the 2005 EDHS (673). A similar conclusion can be drawn comparing the MMR measured in the 2011 EDHS with those in the 2000 EDHS that there is no evidence to suggest that the MMR decreased in Ethiopia between 2000 and 2011. In addition, evidence also so indicates that the

proportion of births attended by a skilled health personnel in Ethiopia is still the lowest (< 20%) in the year 2011 (14-16).

Whether the aforementioned improvements in health outcomes are partly attributed to an increase in inflow of DAH in the country is the focus of this study. While it is expected that the increased inflow in DAH will result in increased improvement in health outcomes, across the world, there is no consensus as to whether DAH improves health outcomes of the recipient country. To worsen the matter, evidence from low income countries who are the most recipient of DAH is scanty. At the same time, the very few available literatures use either commitment or disbursement data in which both cases does not necessarily indicate the actual amount of aid expenditure that the recipient country used for health care provision. Owing to this, the current study aims to analyze the effect of DAHE on health outcome in Ethiopia. The primary contribution of this paper is therefore, to present country specific evidence of DAH effect on health status in Ethiopia.

Methods

Using dynamic time series analytic approach, this paper examines the effect of DAHE on health status in Ethiopia for the period 1978-2013, a sample of 36 series observation. The year 1978, as an initial period of the study is considered for the fact that there is a dearth of complete, comprehensive data prior to this period. Nevertheless, it seems a reasonable initial period as it was the initial year for the historical period of the global declaration “Health for All by the year 2000” through PHC strategies, particularly in developing countries like Ethiopia. that the declaration has been tailored to a strong international collaborations in funding the PHC programe (17). Thus it provides a better insight to examine the relationship between donor’s contribution and the intended change of health outcome in the targeted country during the time-period 1978-2000.

Besides, the study considered the year 2013 as the last period of the study period, because, it was the last recent, comprehensive data found from the common DAH data sources during data collection. Nevertheless, the year 2013 is the year short before the end of Millennium Development Goals (MDGs) implementation year (2015). Consequently, the time-period, 2000-2013 enables to capture the surge in DAH since the enactment of the MDGs, allows better opportunity to examine the effect of the DAH outpouring in the country.

Life expectancy at birth (LEB) is used as a measure of health status for its advantages over the other health status measures and as it has long been used in other studies as a standard measure of health for example in Human Development Index (HDI) (18).

To examine the effects of DAHE on the health status measure, VECM (Vector Error Correction Model) is applied. The vector error correction model is preferred for its

advantage of providing valuable information on the relationships of socio economic variables like the current data. Indeed, beside including time dependency between the variables of interest and allowing for stochastic trends, the model use long-run equilibrium relationships through cointegration. Furthermore, to estimate the cointegrating relations and the other parameters in the model, the standard procedure of Johansen's approach is used (19-21).

The theoretical model

Based up on the previous studies(34,35), the implicit function for our model can be expressed as:

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

Where n is number of explanatory variables. By taking the derivative of both sides of the equation we get:

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

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

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

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

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

where $\delta = f_0$ and α_3 is some constant term. Notice that under the assumption of constant φ_j 's as health status rises the elasticities will fall and vice versa. In this process when health status reaches some given maximum the elasticities will take their minimum value. Thus this model is equivalent to stating the required health status estimating equation in dynamic semi-log-linear form.

Notice that this theoretical model, while retaining most of the useful properties of previous models in literatures (34,35), it assumes stability of the product of the elasticity and the health status instead of stability of the elasticity. It also assumes stability of marginal product of previous level of health status on the present level of health status. Having in place the theoretical frame work, the empirical estimation equations for the study can be specified as:

$$LEB = \beta_0 + \beta_1 \ln DAHE + \beta_2 \ln GDPP + \beta_3 PHE \setminus DAH + \beta_4 FEMED + POP + \varepsilon_t \dots\dots\dots(4)$$

Where,

LEB = Health outcome as measured by life expectancy at birth

DAHE = Development Assistance for Health Expenditure per capita in current USD

PHE \setminus DAH = The rest of public health expenditure other than DAH in per capita current USD

GDPP = Gross domestic product per capita in current USD

PREDFem = Total female enrollment in primary education

POP = Population ages 15 to 64

ε_t = Stochastic disturbance term to capture omitted variables

$t = 1, 2, 3, \dots, 36$ and β s are the parameters to be estimated.

Data and Variables

Data

Data is obtained from internationally and nationally recognized organizations, mainly from the World Bank; World Development Indicator (WDI) (22), World Bank; Africa

Development Indicator(ADI)(23), World Health Organization; global health expenditure data

base (24), Ministry of Finance and Economic Development, Ethiopia (25,26) Central

Statistical Agency of Ethiopia (27-31). All these are exhaustively examined with other

competitive alternative sources, cross checked for comprehensiveness, completeness,

consistency and finally considered as the best alternative sources.

Variables

The dependent variables

1. **Life expectancy at birth (LEB)**: is the average equivalent number of years of full health that a newborn 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 was preferred for it has long been used as a measure of health status in the literatures hence is conventional health status measures. Moreover, in pre identification of the variables it exhibits a stationary pattern after differencing, a basic requirement for time series analysis. Data for this variable was obtained from World Bank (22).

The independent variables

1. **Development Assistance for Health Expenditure (DAHE)**: DAHE in this study is the core variable of interest and it refers to health expenditure that originates from external resources for health funds or services in kind that are provided by entities not part of the country. The resources may come from international organizations, other countries through bilateral arrangements, or foreign nongovernmental organizations(24) and Per capita DAHE in current USD is used for the current study. Multiple data sources were used for this variable. World Bank; world development Indicator (22), World Health Organization; global health expenditure data base (24), Ministry of Finance and Economic Development (25,26) Ethiopia, Central Statistical Agency of Ethiopia (27-31).

2. **The rest of Public Health expenditure (PHEDAH)**: is a control variable in this study representing recurrent and capital spending from government (central and local) budgets, other than DAHE. A per capita PHEDAH in current USD is used for this variable. This variable is considered for the fact that health expenditures that originated from local sources are among the factors known to influence health status of a population as earlier literatures

reported (32-35). Similar to DAHE above, multiple data sources (22,24,27-31) were examined and the aforementioned mentioned best alternative sources were used.

3. GDP per capita (GDPP): GDP per capita in USD is gross domestic product divided by midyear population and the data was obtained from WB, WDI starting from year 1981. The prior three years were computed using multiple data imputation method (22).

4. Total female enrollment in primary education (FEMED), regardless of age, expressed as a percentage of the female population of official primary education age. 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 (22,36). This was the only alternative education indicator found for the sampled year. Otherwise other education indicators like net enrollment and school years would have been better but the data are highly deficient for the sampled year.

5. Population ages 15 to 64 (POP) : is the percentage of the total population that is in the age group 15 to 64. Population is based on the de facto definition of population and data is obtained from WDI (22)

Results

Descriptive results

As the descriptive results shows in Table 1, the Mean ($\pm$ SD) of LEB and DAHE during the sampled period of the study is 51(6.44) and 1.73(2.61) respectively. The range is between 43.67 and 63.62 for LEB and 0.05 and 9.06 for DAHE. Similarly, the mean ($\pm$ SD) for the remaining variables, namely, GDPP, PHE'DAH, FEMED, and POP is 218.92(96.34), 1.62(1.66), 46.16(27.59), and 3.06E+07 (9940617) respectively. For detail see Table 1.

Table 10. Health and the related indicators summary statistics, Ethiopia, 1978-2013.

Variables	Definitions	Obs	Mean	Std. Dev.	Min	Max
LEB	Life expectancy at birth	36	51.069	6.437	43.674	63.617
DAHE	Development assistance for health expenditure per capita	36	1.727	2.612	0.050	9.057
GDPP	Gross domestic product per capita	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	36	46.157	27.585	13.906	100.546
POP	Total Population aged 15 to 64 years	36	3.06E+07	9940617	1.80E+07	5.10E+07

At the same time, Fig.1 illustrates trends in LEB and DAHE in Ethiopia during the study period of time. As can be observed from the figure, starting from the mid 1980s, LEB follows a steady upward trend without interruption throughout the observation period. A more pronounced upward trend in LEB can also be observed after the year 2000(Fig 1). While looking in to the pattern of DAHE, the change from 1978 to 1994 is minimal and small in amount (around 0.5 USD) with slight upward increments until 2000, followed by a

small down ward, and then a sharp increasing trend between 2003 and 2008 and again with slight decrease trend in 2009, then gain upward trend until the year 2012, then after, there is a hint of a declining trend as can be seen in the Fig 1. The figure informs that the country has experienced an improved health outcomes as measured by LEB that increased steadily, along with a growth(with some variation) in the DAHE.

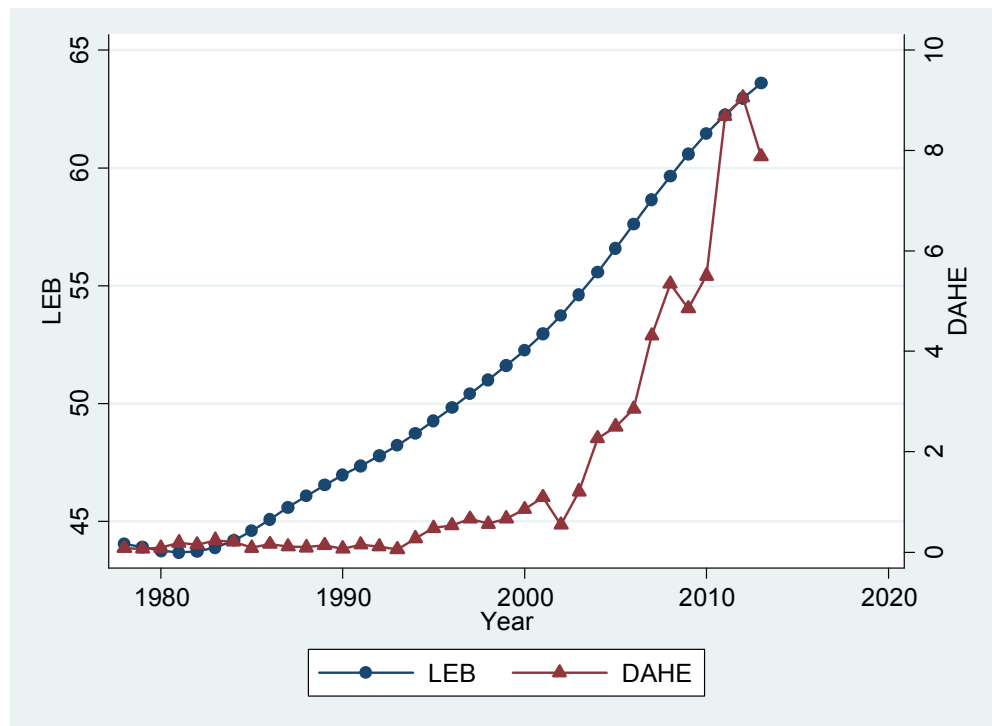


Fig.1. trends in LEB and DAHE in Ethiopia 1978-2013

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.

One can clearly observe this in Fig 2, a plot of local polynomial smooth curve of change in LEB on DAHE. The figure informs that DAHE is increasingly effective in continuous, and steady increasing of LEB from about 1.00 USD per capita to about 7.00 USD per capita and the change seems to be constant then after. Even if the positive relationship is clearly

observed here again, at this step, one can't conclude the causal effect of DAHE on LEB without further econometric investigation as proceeded by the next section.

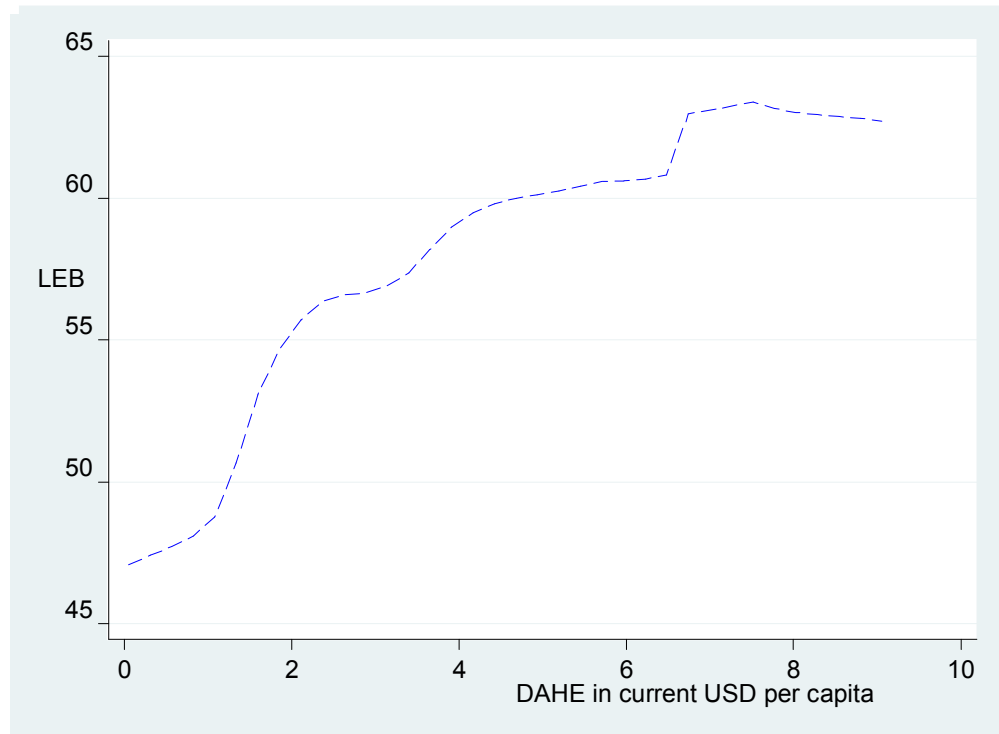


Figure 2. A plot of local polynomial smooth curve of LEB on development assistance for health per capita USD, Ethiopia, 1978-2013.

The Unit root test

The econometric analysis of data under the current study proceeds by testing for stationarity of each series as is common in time series data analysis. All the included variables (LEB, DAHE GDPP, DAHE²DAH, FEMED and POP) were undergone the standard Augmented Dickey Fuller (ADF) and Philip-Perron test to avoid the spurious results that would make the estimate biased and inconsistent (37-39). The results from the test based on ADF and Philip-Perron are presented in Table 2. Both tests, though consistent with each other, are included to ensure accuracy regarding the unit root conclusion. The tests allow for the presence of both intercept and trend and without intercept and trend both at level and first

difference. Accordingly, the result shows that all the variables at level are not stationary, but after the first differencing, they all display a stationary behavior (Table 2.). Therefore it can be surmised that the estimated variables are integrated of order one, I (1) process that guarantee to proceed to the next step of examining the presence of long run equilibrium relationship between DAHE and LEB in the regression through the multivariate Johansen-Juselius cointegration test (21,39).

Table 11. ADF unit root test results at level and first difference

	With intercept no trend		With intercept and trend	
	Levels	1 st Difference	Levels	1 st Difference
lnLEB	7.584	-3.008*	-2.307	-6.982**
lnDAHE	-0.519	-7.571**	-2.598	-7.503**
lnGDPP	0.449	-3.406*	0.222	-3.678*
lnPHE'DAH	-0.811	-6.970**	-2.984	-6.852**
lnFEMED	-0.114	-3.108*	-1.085	-4.036**
lnPOP	4.318	-4.006**	-2.529	-3.396*

*Null hypothesis rejected at 5%, **Null hypothesis rejected at 1%.

The co-integration test

As a standard, cointegration test provides a framework for estimation, inference and interpretation in non-stationary data with first difference stationary like the current analysis, (38).

Therefore, in this study; Johansen method of cointegration test (21,39) is applied to ascertain the existence of convergence between the long run equilibrium and the short run dynamics of the data under the study. In the output of Johansen tests for co-integration as indicated in Table 3. The null hypotheses of no co-integration is strongly rejected and fail to reject the null hypothesis of at most one co-integrating equation. Thus, the model accepts the null hypothesis that there is one co-integrating equation in the targeted variable model (Table 3).

Table 12. The Co-integration rank results

Co-integrating Vector (lnLEB, lnDAHE, lnGDPP, lnPHE-DAHE, lnFEMED,lnPOP15-64)		
Null Hypothesis (Maximum rank)	Trace-Statistics	Maximum Eigen Statistics
r=0	67.669	36.024
r=1	31.645*	22.115
r=2	12.568	11.118
r=3	9.529	8.516
r=4	1.450	1.440
r=5	0.763	0.763

*Null hypothesis rejected at 1%

Basically, the explicit choice of lag – length is required to proceed with the analysis of the model under consideration in this study. Accordingly, the Akaike information criterion (AIC) is used to determine the lag length of the model. The AIC is chosen for decision in the current study because Liews (39) suggest that AIC performed better than any other information criterions when the estimated sample size is relatively small (e.g. less than 60 observations). However in the current study similar result is conveyed by Schwarz Bayesian information criterion (SBIC), Hannan-Quinn information criteria (HQIC) sequential likelihood-ratio (LR) test as shown in Table 4. Akaike information criterion (AIC) and its companion criterion all indicate to choose three lags, as indicated by the “*” in the Table 4.

Table 13. The Lag order selection statistics

lag	LL	LR	AIC	HQIC	SBIC
0	-122.331	NA	8.0214	8.0515	8.1139
1	-0.913	242.840	0.446	0.536	0.724
2	35.943	73.711	-1.674	-1.523	-1.211
3	68.630	65.375*	-3.525*	-3.313*	-2.877*
4	105.907	74.554	-5.672	-5.401	-4.839

Result from ECM

It has been determined that there is stationarity and co-integration of the series between the variables in the regression model as stated previously. Next, to account for the relationship of variables, both in the short run and in the long run, the Error Correction Method (ECM) is employed. Consequently, the ECM relates the short run changes in LEB, the dependent variable, to the short run changes in the DAH, the main variable of interest, and the remaining explanatory variables in the model in linking with the changes in the long run effect. The result is depicted in Table 5..

The result reveals that the long run relationship among the variables in the model is well captured by the specified ECM term(ECM-1) as indicated in the Table 5, and the coefficient estimate of ECM-1 is negative and significant at 1% level explaining the speed of adjustment between the short run and long run, never the less, slow.

Table 14. The ECM estimation results,Ethiopia,1978-2013.

Dependent variable is LEB

Variables	Coefficient	Std. Err.	t-Values	probability
ECt-1	-0.011	0.001	-9.070	0.000
LEB LD.	1.822	0.039	46.870	0.000
LEB L2D.	-1.080	0.052	-20.930	0.000
lnDAHE LD.	0.026	0.004	6.160	0.000
lnDAHE L2D.	0.008	0.004	2.240	0.025
lnGDPP LD.	0.083	0.023	3.600	0.000
lnGDPP L2D.	0.086	0.024	3.620	0.000
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	0.000

***indicates that the Joint effect significant, *indicates that the Joint effect is insignificant*

As can be seen from the Table 5, the estimated coefficient is -0.011 implying that about 1.1% of the disequilibrium in the previous year (year t-1) in LEB are corrected in the current year period. The result further displays that the variables in the model are all in the first differenced form representing the short run elasticity of LEB with regard to DAHE, and the remaining explanatory variables. As the result shows, the short run effect of DAHE on LEB is positive and significant. The immediate past period of DAHE significantly affect the current level of LEB positively at 1% significance level implying that other things being equal, an increase of DAHE by 1% leads to an improvement in life expectancy at birth by approximately 9 days (P=0.000). Similarly, the result suggest that there is a statistically

significant positive association between the two immediate period of DAHE and LEB, suggesting a 1 % increase in DAHE the two immediate period improves the current LEB by about 3 days ($P=0.025$). The association of the rest of Public health expenditure during the immediate two previous period is also positive and significant ($P=0.013$), indicating a 1 % increase of PHEDAH during the immediate two previous year leads to similar 3 days improvement in current LEB like that of DAHE effect of immediate two previous year (Table 5).

The association between GDPP and LEB is also found to be statistically significant ($p=0.000$) 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. Table 5, further displays 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 as shown in Table 5.

Post-Estimation Diagnostics Test

The Normality test

Among the requirements for the current model, is a test of normal distribution of the error terms in the regression model. The normality test is employed to ascertain normal distribution of error term and the result is depicted in the Table 6. In this test, the null hypothesis for the Jarque- Bera statistics is that the error term in the model equation has normal distribution. In the current model, the overall Jarque-Bera statistics doesn't reject the null of normality at 5%. Similarly, the null hypothesis test that the disturbance terms in all equations jointly in the model have zero skewness is not rejected at 5% significance level; hence, the result doesn't suggest non normality as shown in the Table 6. At the same time, the Kurtosis statistics

presented in the Table 6, tests the null hypothesis that the disturbance terms are normally distributed is consistent with normality since the result fail to reject the null hypothesis at 5% significance level (Table 6).

Table 15. The test for normal distribution of residuals

Component	Test Criterion	Joint χ^2	Probability
6	Jarque-Bera	8.820	0.718
6	Skewness	6.977	0.323
6	Kurtosis	1.843	0.934

Test for residual serial autocorrelation

Table 7 presents the results of the Lagrange Multiplier (LM) test for residual serial autocorrelation implying that, there is no problem of autocorrelation in the estimated model at 5% ,as the test fail to reject the null hypothesis of no autocorrelation among residuals (Table 7).

Table 16. The test for residual autocorrelation

Lag	χ^2	Probability
1	27.520	0.844
2	29.157	0.784

Discussion

This study describes the patterns of LEB and DAHE in Ethiopia using a sample of 36 years observation, from the year 1978 to 2013 as a preliminary analysis of the effect of DAH on health status in Ethiopia. Accordingly, the trend in DAHE per capita in Ethiopia during the period from 1978 up to the mid 1990s is very small, around 0.5 USD. this might be due to the then communist regime's close economic policy to the outer world that might have limited the support particularly from the western world (40). DAH, after slight progress, at about 1.00 USD per capita throughout the 1990s, a short decline around 2000 is observed, that might have been an attribute of the Ethio- Eritrean war of the 1998-2000 (40). The increased trend observed in DAHE after the mid 1990s might also be an attribute of improved national health account system in collaboration with international organizations like WB and WHO (22,24).

However, short after 2000, DAH has shown a steady increasing trend throughout the 2012 but around 2010. This might be a result of global financiers' response to the MDGs implementation. A short decline noted around 2010 might be due to the global financial crisis of the 2008 since the current year expenditure report originates from the preceding years of disbarments (41).

This study informs that, in general, there is an increasing trend in DAHE from the year 2000 onwards that might be an attribute of the high inflow of DAH owing to MDGs implementation period that has accompanied by increased donor participation (42). In general the mean ($\pm$ SD) of DAHE during the study period (1978-2013) is 1.73(2.61), the minimum being 0.05, and the maximum 9.06. The overall descriptive pattern of DAH in Ethiopia during the study period has increased overtime however. It would have been more

reasonable to compare this figure with other similar SSA countries, however due to limitation of information for other similar countries for the aforementioned period of year is very limited, that couldn't be made.

The result from the current study also informs there is an increasing trend in health status as measured by LEB in general, starting from the mid 1980s, and after the mid 1990s in particular.

This might be an attribute of the country's adoption of PHC strategy and MDGs as a signatory (43).

The ultimate objective of this study is to investigate the effect of development assistance on health status in Ethiopia. Accordingly, the effect of DAHE, is found to have a significant long run influence on the health status of the population in country. As the result suggests, the coefficient of ECT_{t-1} , though small, has the correct negative sign and is statistically significant ($P=0.000$) 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 observed in the current result is greater than the findings of (Bendavid & Bhattacharya) that reports the an increase of 0.02 month in LEB can be explained by DAH. However, Bendavid & Bhattacharya studied on 140 aid-recipient countries between 1974 and 2010. While the time period is more or less similar, the applied methodology in their study is

panel analytic approach (time series - cross section)(44). So the observed difference might be an account of methodological difference as this study is country specific time series, in a country with higher inflow of the DAH and have a better performance record in health indicators. Similarly, the result is higher than one cross country study, reported LEB elasticity to DAHE in SSA, which is 0.005 year (45). Again the difference more likely to show the evidence of better performance in Ethiopia regarding DAHE's effect on health outcome in the currently. Meaning an increase of DAH has been resulted in an increased life expectancy, even better than that of the average SSA. This might be an attribute of implementation of PHC in the country that is always accompanied by strong health policy commitment in the country, as for example deployment of health extension workers with proximity to the community, and where most of DAHE is changed in to the service. (46,47).

At the same time, both the magnitude and direction of the elasticity estimates of the current result is consistent with a country specific study conducted in Pakistan, that reported 0.024 (48) 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, while in fact the Pakistan study considers total public expenditure (48).

On the other hand, the current findings contradicts previous conclusions that claim health aid has no effect in developing countries (6,7,49).

With regard to the remaining control variables, starting first by considering PHEDAH, a 1% increase in PHEDAH in the year immediately preceding the period improves LEB by about 0.008 year. This result is higher compared to a cross country study conducted for SSA that

estimates 0.003. It seems that the effect of the rest of public health expenditure which is in fact domestic funding for health expenditure in Ethiopia has also exhibited more effect in explaining LEB than that of average SSA do(45). That might be an attribute of the policy commitment to implement PHC in the country.

In this study GDP per capita has got a positive significant effect on LEB and this finding is consistent with results reported elsewhere(32,34) as 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. While female's education is considered an important determinant of health status, in this study it shows unexpected sign though not significant, this might be due to the possible existence of correlation with lagged LEB.

Finally, 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. While the positive association is as expected, that 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(45).

In this study, it would have been better had it been controlled with more variables like environmental sanitation and safe water supplies since these factors are known variables to explain health status in developing countries. However, both variables were not included because, first, there is no adequate data series for both variables. Second, the national health

account report, a report from where DAHE originates indicates that total health expenditure among which public expenditure is the main one, includes spending on both core and health-related activities such as drinking water and environmental health spending (11) .

In addition, health professionals to population ratio and governance are another indicators one would expects to be included. However, all health facilities performance related activities is largely an attribute of recurrent and capital health expenditure 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 expenditure lead to a possible higher multi colliniarity among the variables.

Conclusion and recommendation

Contrary to skeptics, this study observes the fact that development assistance for health sector has a strong favorable effect in improving health status in Ethiopia. The policy implication of the current findings is, whilst, development assistance for the health sector should continue as an interim necessity means to an end, domestic health financing system like the health insurance already initiated in the country should be strengthened.

It is al so recommended that, parallel to the current strategy of PHC that assumes **Health providers** (the health care facilities like district hospitals, health centers, health posts...) provision of the services to the population, DAH stakeholders, particularly the NGOs should also think of parallel strategy in targeting direct households (**health consumers- producer approach**). Since the households who consume health do have also a potential to produce health , they should be targeted for an **integrated health development packages** (nutrition, education, improve income e.g. animal husbandry, communication, promotion of productive

health behavior...).Most importantly,the interaction of these package, if targeted, is likely to yield a sustainable, more efficient and effective improvements in health outcome.

Acknowledgements

We are grateful to Addis Ababa University School of public health for enabling us conduct this research with the necessary resources..

We would also like to extend our gratitude to WB,WHO,CSA,MOFEC and FMOH for publically availing the data used in this study .

References

1. Levine R. Millions Saved: Proven Successes in Global Health. In: Kinder, M.(ed.) What Works Working Group. Washington DC: Centre for Global Development.2004.
2. Mishra P and Newhouse D. Does Health Aid Matter?. Journal of Health Economics.2009; (28): 855-872.
3. Ebeke C& Drabo A. Remittances, Public Health Spending and Foreign Aid in the Access to Health Care Services in Developing Countries .Etudes et Documents E 2010.04;2010.Available from <https://halshs.archives-ouvertes.fr/halshs-00552996/document> .[Accessed Sept 9,2015].
4. Chauvet L F, Gubert & MespleS. Aid, Remittances, Medical Brain Drain and Child Mortality: Evidence Using Inter and Intra-Country Data". Journal of Development Studies. 2013; 49: 801-818.
5. Gormanee K. S. Girma, and Morrissey O. Aid, Public Spending and Human Welfare: Evidence from Quantile Regressions. Journal of International Development. 2005;17, 299-309.
6. Williamson C.R. Foreign Aid and Human Development, the Impact of Foreign Aid to the Health Sector. Southern Economic Journal.2008; 75: 188-207.
7. Wilson S. Chasing Success, Health Sector Aid and Mortality. World Development.2011; 39, 2032-43.
8. Ravishankar N, et al. Financing of global health, tracking development assistance for health from 1990 to 2007. The Lancet. 2009; (373) : 2113–24.
9. Alemu G, A case study on aid effectiveness in Ethiopia: Analysis of the health sector aid architecture. Wolfensohn center for development: Working paper 9. April, 2009.Availablefrom: http://www.brookings.edu/~media/research/files/papers/2009/4/ethiopia-aid-alemu/04_ethiopia_aid_alemu.pdf. [Accessed June 5,2016].
10. Graves MC, Haakenstad A & Dieleman LJ.Tracking development assistance for health to fragile states.Globalization and Health. 2015; 11:12. Available from: DOI 10.1186/s12992-015-0097-9. [Accessed: May 5,2016].
11. Ethiopia Federal Ministry of Health. Ethiopia's Fifth National Health Accounts 2010/2011. April 2014; Addis Ababa, Ethiopia.

12. Economic Commission for Africa. Assessing Progress in Africa toward the Millennium Development Goals. MDG report 2015, ECA Documents Publishing Unit 2015.
13. Federal Democratic Republic of Ethiopia Ministry of Health. policy and practice information for action. Quarterly Health Bulletin. 2014; 6 (1): 3-4.
14. Central Statistical Authority [Ethiopia] and ORC Macro. Ethiopia Demographic and Health Survey 2000. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Authority and ORC Macro ;2001.
15. Central Statistical Agency [Ethiopia] and ORC Macro. Ethiopia Demographic and Health Survey 2005. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ORC Macro;2006.
16. Central Statistical Agency [Ethiopia] and ICF International. Ethiopia Demographic and Health Survey 2011. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ICF International;2012.
17. Declaration of Alma-Ata. International Conference on Primary Health Care, Alma-Ata, USSR, 6-12. September 1978. Available http://www.who.int/publications/almaata_declaration_en.pdf [Accessed: May 30,2016].
18. Human Development Index. In Wikipedia, The Free Encyclopedia. Available: https://en.wikipedia.org/w/index.php?title=Human_DevelopmentIndex&oldid=725604668. [Accessed June 16,2016].
19. Gaille S and Sherris M. Modeling Mortality with Common Stochastic Long-Run Trends. The Geneva Papers on Risk and Insurance - Issues and Practice. 2011;36(4):595–621.
20. Gaille S and Sherris M. Forecasting Mortality Trends allowing for Cause-of-Death Mortality Dependence. North American Actuarial Journal. 2013; 17(4):273–282.
21. Johansen S. Statistical Analysis of Cointegration Vectors. Journal of Economic Dynamics and Control. 1988; 12: 231-25
22. World Bank. World Development Indicators, Ethiopia. 2015. Available: http://data.worldbank.org/country/ethiopia#cp_wdi. [Accessed: April 19,2016].
23. World Bank. African Development Indicators. 2015. Available: <http://data.worldbank.org/data-catalog/africa-development-indicators>. [Accessed April 19, 2016].

24. World Health organization. Global health expenditure .Available from: <http://apps.who.int/nha/database>. [accessed June 3,2016].
25. Ministry of Finance, tubular profile of Ethiopia public revenue and Expenditure, 1949/50-1991/1992, revised. Planning and research department, Ministry of finance, Addis Ababa.oct 1995.P.7-14.
26. Central Government revenue, Capital expenditure by source, foreign assistance, 1965/66-1988/89.p 19.
27. Central Statistics Agency. “Federal Democratic Republic of Ethiopia, statistical abstracts, CSA.1978.p.158-160.
28. Central Statistics Agency. “Federal Democratic Republic of Ethiopia, statistical abstracts, CSA.1980.p.189.
29. Central Statistics Agency. “Federal Democratic Republic of Ethiopia, statistical abstracts, CSA.1990.p.196-197.
30. Central Statistics Agency. “Federal Democratic Republic of Ethiopia, statistical abstracts, CSA.1992.p.208.
31. Central Statistics Agency. “Federal Democratic Republic of Ethiopia, statistical abstracts, CSA.1995.p.235.
32. Aisa, R., Clemente, J., Pueyo, F. (2014) The influence of (public) health expenditure on longevity. *International Journal of Public Health* 59:867–875.
33. Navignon, J., Olakojo,SA., and Nonvignon,J. (2012) The effects of public and private health care expenditure on health status in sub-Saharan Africa: new evidence from panel data analysis.*Health Economics Review* 2(22):1-8.
34. Filmer D. & Pritchett L.The impact of public spending on health: Does money matter? *Social Science and Medicine*.1999; 49:1309–1323.
35. Akinkugbe O, Mohanoe M.Public Health Expenditure as a Determinant of Health Status in Lesotho. *Social Work in Public Health*.2009; 24;131–147.
36. World Bank. African Development Indicators.2015.Available:<http://data.worldbank.org/data-catalog/africa-development-indicators>. [Accessed April 19, 2016].
37. Dickey DA, Fuller WA. Likelihood ratios for autoregressive time series. *Econometrica*. 1981; 49:1057–1172.
38. Phillips PCB ,Perron P. (1988) Testing for Unit Roots in Time Series Regression. *Biometrika*. 75 (2):335–346.

39. Liew K.S. Which lag length selection criteria should we employed? *Economics Bulletin*.2004; 3: pp. 1-9.
40. Foreign aid to Ethiopia. In Wikipedia. The Free Encyclopedia. 2014 ;, Available: https://en.wikipedia.org/w/index.php?title=Foreign_aid_to_Ethiopia&oldid=623989114. [Accessed June 17, 2016].
41. International Monetary Fund. Impact of the Global Financial Crisis on Sub-Saharan Africa, African department.2009; IMF Multimedia Services Division. Available: <https://www.imf.org/external/pubs/ft/books/2009/afrglobfin/ssaglobalfin.pdf>. [Accessed June 17, 2016].
42. Dieleman LJ, et al. Sources and Focus of Health Development Assistance, 1990–2014. *JAMA*. 2015;313(23):2359-2368. doi:10.1001/jama.2015.5825. [Accessed June 5, 2016].
43. Kitew Y, Teka G, Meche H. Lessons from the evolution of human resources for health in Ethiopia: 1941-2010. *Ethiop. J. Health Dev*. 2013;27(Special Issue 1).
44. Bendavid E, Bhattacharya J. The Relationship of Health Aid to Population Health Improvements. *JAMA Intern Med*. 2014 ; 174(6): 881–887. doi:10.1001/jamainternmed.2014.292. [Accessed June 6, 2016].
45. Ssozy J, Amlani S. The Effectiveness of Health Expenditure on the Proximate and Ultimate Goals of Healthcare in Sub-Saharan Africa. *World Development*.2015; 76: 165-179.
46. Shaw PR, Wang H, Kress D. & Hovig D. Donor and Domestic Financing of Primary Health Care in Low Income Countries. *Health Systems & Reform*. 2015;1(1): 72-88 Available: <http://dx.doi.org/10.1080/23288604.2014.996413>. [Accessed June 6, 2016].
47. The Federal Democratic Republic of Ethiopia, Ministry of Health. Health sector transformation plan 2015/16 - 2019/20. Addis Ababa; October, 2015.
48. Anwar S, Rana AM, Nasreen S, Evaluation of the Contribution of Public Health Expenditure on Health in Pakistan: A Time- Series Analysis. *The Empirical Economics Letters*.2012; 11:10.
49. Kosack S. & Tobin J. (2006). Funding self-sustaining development: The role of aid, FDI and government in economic success. *International organization*, 60(1), 205–243.

Paper III

The effect of Health Expenditures on Health outcomes in Ethiopia: Evidence from Time series data analysis

¹Keneni GutemaNegeri, ²Damen Hailemariam

¹School of Public and Environmental Health
Health Service Management Unit

²College of Medicine and Health Sciences
Hawassa University, Hawassa

Abstract: The effect of health expenditures on health outcome is inconclusive. Besides, a country specific study from developing countries like Ethiopia is very limited. Using a time series data analytic approach we examine the effect of health expenditures on health out come in Ethiopia. The result shows evidence of health expenditures effect in reducing infant mortality. A 1% increase in the total health expenditures as a share of GDP reduces infant mortality rate by 34 (P=0.000). Besides, improvements in food production and female education are significant contributors to the improvements of health status in the country. The policy implication of the current findings is, whilst, increasing the health expenditures to levels that are compatible is recommended, socioeconomic factors namely, female education, and food production plays a pivotal role to improve the health status in the country. These in turn help to achieve the nationally and internationally aspired Sustainable Development Goals.

Keywords: health expenditures, health status, infant mortality, time series

Introduction

Ensuring healthy lives and promoting well-being for all at all ages is among the key targets of the United Nations Sustainable Development Goals (SDGs).¹Expenditure on health is among the core issue of concern which dominates policy discussion both at national and global level,²more so in African countries where severe budget constraints apply and where health outcomes are among the lowest in the world.³While the relationship between health expenditures and health outcomes continues to attract the attention of policy makers and health funding organizations at national and international levels, evidences from developing countries are limited, particularly for Sub Saharan Africa (SSA)if not none for Ethiopia. Findings from the available literature are also inconclusive, reporting a range from no effect to substantially significant effect. Consequently, this study seeks to contribute to filling this gap by exploring data from Ethiopia. The objective of this study is therefore, to examine the health expenditures effect on health outcome in Ethiopia using infant mortality rate as a proxy for health outcome.

Filmer&Pritchett,using cross-national data of 100 countries, find statistically insignificant effect of public health care spending on infant and under-five child mortality. According to their report, other socio economic variables that include income, and educational status as measured by years of female schooling, explains 95 percent of variation in infant and under-five mortality⁴.

On similar vein, Lopes examines the effect of government social spending on both health and education status measures and finds that social spending indicators does not strongly explain the health and education outcomes with the exception of female secondary education enrollment.⁵

Rimanet. al., using annual time series data from 1980- 2004 in Nigeria didn't see any significant long-run relationship existing between government health expenditure and health status as measured by life expectancy at birth.⁶

On the other hand,Lichtenberg, examined the effect of separate public health expenditure and private health expenditure on longevity using annual time series data of 1960 to 2001 in the US and finds a significant effect of public health expenditures on longevity while not for that of private health expenditure.⁷

Self and Grabowski,using cross sectional data of 191 countries find that a greater health status outcome, as measured by Disability Adjusted Life Expectancy (DALE), is not a result of higher public health expenditures in developed countries, whereas it improves the health status of developing countries significantly. They also reported a significant effect of separate private expenditure on health in a total sample of developed and developing countries but become insignificant when separated in to developed and developing countries.⁸Similarly,Aisa et.al., using a cross-country sample of OECD countries over the period 1980–2000.explore the effect of an aggregate and disaggregated health expenditures on longevity. In their sample,the aggregate health expenditure is not significant in explaining growth of longevity. However when they employ a separate specification for public health expenditure, it appears to be a significant explanatory variable of longevity.⁹The effect of health expenditure, that it has positive significant effect on health status is also well recognized in other studies.¹⁰⁻¹⁴

Ethiopia has shown a remarkable increase in health expenditures, both in nominal and per capita terms.¹⁵For example, Per capita health spending rose from 4.50 USD in 1995/1996 to 7.10 USD in 2003/2004 and reached 20.70 USD in the year 2010/2011.Though far from the WHO's recommended 60 USD per capita to deliver essential health care in low-income

countries,¹⁶ it is believed to be committed for access to and utilization of health services and overall health status improvement in a country. There has been a noticeable progressive improvement in overall health status over time in the country.¹⁵ Evidences from various sources shows that health outcomes in the country has improved in the last one to two decades.¹⁷⁻²⁰. According to Ethiopia Demographic and Health Survey (EDHS) report of the year 2000, 2005 and 2011, infant mortality rate decreased from 97 in the year 2000 to 59 in the year 2011, and under-five mortality rate decreased from 166 to 88 during the same period of the survey.¹⁷⁻¹⁹In consideration with the out gone Millennium Development Goals (MDGs), under-five mortality rate is reduced by two thirds between 1990 and 2015 and the country has achieved two years before the target year of the MDGs.²⁰

Whether the aforementioned progresses in health outcomes are partly attributed to expenditure on health in the country, and if so, to what extent, is the focus of this study to contribute to the achievement of the strived SDGs in a country.

Methods

A time series data analytic approach is employed, using health expenditure as an explanatory variable and infant mortality as a proxy for health status indicator, covering the period from 1995 to 2013 in Ethiopia. This sample period of time is conveniently selected for the availability of comprehensive and complete data for our study variables.

Theoretical frame work

The framework of the current study follows the work of Filmer& Pritchett and Akinkugbe&Mohanoe).^{4,12} Thus,

$$\text{Health status} = (H_i/N_i)^\alpha (N_{Hi}/N_i)^\beta \times e^{A_i} \dots\dots\dots (1)$$

Where:

Health Status = Infant Mortality Rate(IMR), H_i = public expenditure in the health sector of country, N_{Hi} = the rest of GDP (including all non-public sector health spending), N = population, A = country-specific factors (access to safe water, access to sanitation, female education, location of a country, income inequality)

Dividing both the numerators and denominators of equation (1) by GDP and taking double-logarithm results in the following:

$$\ln(\text{Health Status}) = \alpha \ln(H_i/GDP_i) + \beta \ln(N_{Hi}/GDP_i) + (\alpha + \beta) \ln(GDP_i/N) + A_i \dots\dots\dots (2)$$

Where:

$\ln(\text{Health Status})$ = log of infant mortality, $\ln(H_i/GDP_i)$ = log of the public health expenditures as a share of GDP, $\beta \ln(N_{Hi}/GDP_i)$ = log of rest of GDP as a share of GDP, $\ln(GDP_i/N)$ = GDP per capita, A_i = country-specific factors as explained in equation (1) above, α ($\alpha + \beta$) = elasticities

Model Specification

Following the aforementioned theoretical frameworks, the current study can be specified by considering the log linear model for its advantage over level-level regression as stated elsewhere^{4,5,9,11,12} and specified as:

$$\ln HSt = \beta_0 + \beta_1 \ln THE + \beta_2 \ln GDPP + \beta_3 \ln FemED + \beta_4 \ln FOOD + \beta_5 \ln INF + \beta_6 \ln URBP + \varepsilon_t \dots \dots \dots (3)$$

Where:

$\ln HS$ = log of Health Status as measured by infant mortality rate, THE = Health Expenditure as a % of GDP, $\ln GDPP$ = log of per capita GDP in constant 2005 U.S. dollars, $\ln FemED$ = log of Female secondary school enrolment ratio, $Food$ = Food production index, INF = Inflation, consumer prices (annual %), $URBP$ = Urban population growth (annual %), ε = stochastic disturbance term to capture omitted variables and $t = 1, 2, 3, \dots, 19$ and β s are the parameters to be estimated.

Equation(3) assumes the stability of IMR elasticity with respect to the explanatory variables as is considered in previous studies^{4,12} that presume the possibility of sustained improvements in IMR. However, in Equation(4), level-log equation is specified to help introduce additional alternative assumption that consider in to account the stability of marginal effect of THE on IMR to account for the stability of the elasticity of IMR with regard to THE in the cases of extreme level of health status.²¹ In this case, the coefficient estimates can inform the unit change in IMR level as a result of a 1% change in THE and this can be specified as:

$$HSt = \beta_0 + \beta_1 \ln THE + \beta_2 \ln GDPP + \beta_3 \ln FemED + \beta_4 \ln FOOD + \beta_5 \ln INF + \beta_6 \ln URBP + \varepsilon_t \dots \dots \dots (4)$$

Equation 3 and 4 are estimated using Newey–West method to account for the autocorrelation and heteroscedasticity of the error term in the regression mode.²²⁻²⁴ At the same time, we

ascertained the stationarity of the regression residuals using both AugmentedDickey-Fuller(ADF)²⁵ and Phillips–Perron(PP)²⁶ unit root test.

Data and Variables

Our data is obtained from World Bank World Development Indicators (WDI) and the operational definition of the variables also follows the same source.²⁷

Infant Mortality Rate (IMR): refers to infants dying before reaching one year of age, per 1,000 live births in a given year. Since IMR is more sensitive to changes in health and other socioeconomic conditions of low-income economies²⁸ and a bulk of previous literatures used it, it is also our variable of choice as a measure of health outcome.²⁹⁻³¹

Total Health Expenditure as % of GDP (THE): denotes the sum of public and private health expenditure and covers the provision preventive and curative health services²⁷ In the Ethiopian context THE includes spending on both core health and health-related activities including hygiene, drinking water and environmental health.¹⁵ An increased THE is expected to relate to lower IMR.

GDP per capita (GDPP): GDP per capita is gross domestic product divided by midyear population and is in constant 2005 U.S. dollars.²⁷

Percentage of Female secondary school enrolment ratio (gross)(FemEd): refers to total female enrollment in secondary education, regardless of age, expressed as a percentage of the female population of official secondary education age. **Food production index(FOOD):** covers food crops that are considered edible and that contain nutrients. Coffee and tea are excluded because, although edible, they have no nutritive value.²⁷

Inflation, consumer prices (annual %) (INF): Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring

a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.²⁷

Urban population growth (annual %) (URBP): Urban population refers to people living in urban areas as defined by national statistical offices.²⁷

Results and discussion

As the descriptive results shows in Table 1, the Mean (SD) of IMR and THE during the time period for the study is 74(20) and 4.33(0.66). Compared to SSA mean(SD) IMR 82(14.77) and THE 6 (0.27), the declining rate of IMR in Ethiopia is higher with lower THE. Other control variables, namely, GDPP, FemED, FOOD, INF and URB is 177.83(53.54), 19.73(9.75), 97.53(30.07), 10.29(13.00) and 4.45(0.41) respectively. Similar to THE, the mean value of control variables in Ethiopia are lower than that of SSA. For detail see Table 1.

Table1. Variable names and summary statistics

Variables	Definition	Ethiopia		SSA	
		Mean	Std. Dev.	Mean	Std. Dev.
IMR	Infant Mortality Rate	74	20.410	82	14.772
THE	Total Health Expenditure as % of GDP	4.330	0.659	5.956	0.272
GDPP	Growth Domestic Product Per capita	177.831	53.539	864.694	98.369
FemED	Female secondary school enrolment ratio, gross	19.730	9.747	28.944	6.105
FOOD	Food production index	97.526	30.069	96.826	18.529
INF	Inflation, consumer prices (annual %)	10.286	12.999	6.490	2.099
URBP	Urban population growth rate	4.452	0.409	4.082	0.116

Fig 1 is a plot of local polynomial smooth curve of IMR on THE. The plot shows the association of THE to IMR, indicating, an increase in THE with decrease in IMR, but the effectiveness of decrease in IMR seems to be low at lower and higher percentage of THE. At lower rate of THE, the lower change in decrease of IMR is not unexpected because of the increased need for THE to provide the basic primary health care services that would otherwise lead to higher IMR.

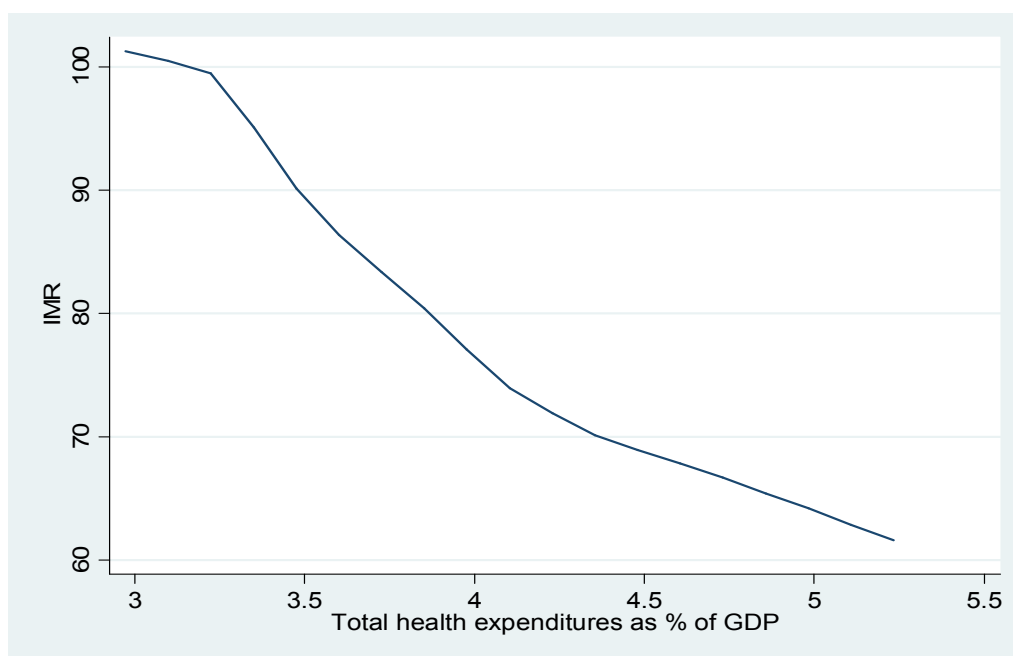


Fig1 A plot of local polynomial smooth curve of IMR on THE

One can clearly observe this in Fig 2, a plot of local polynomial smooth curve of change in IMR on THE. The figure informs that THE is increasingly effective in decreasing IMR from about 3.5% of GDP to about 4.2 % of GDP and less effective below 3.5 % of GDP, and above 4.25% as depicted in Fig2.

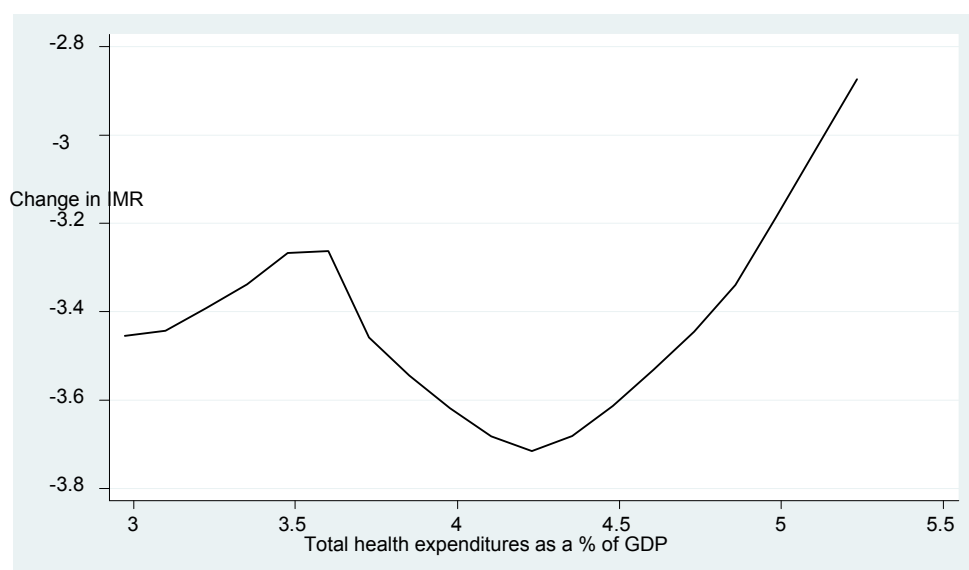


Fig 2 A plot of local polynomial smooth curves showing change in IMR on THE

In considering the effect of health expenditures on health outcome, first, we examine the effect of THE on IMR, using the log-log transformed equation hereafter termed as Model I, as is usual in the literature^{4,9,12} and the results presented in Table 2. Then, we examine result from level-log transformed equation, hereafter termed as Model II, the results shown in Table 3. Both ADF and PP unit root test for the regression residuals are also shown under each table.

A first look in to Model I, as shown in Table 2, the coefficient estimate of THE with respect to IMR is negative and statistically significant ($P=0.003$) entailing, a 1 percent increase in THE reduce IMR by 33% percent. At the same time the ADF test for the unit root in the regression residuals for the Model I rejects the presence of unit root in the residuals ($Z(t) = -4.030$, $P=0.001$). The alternative PP test also rejects the null hypothesis stating the presence of unit roots in the residuals ($Z(t) = -4.217$, $P=0.001$). Apart from this, the coefficient estimate of the other control variables, namely, FOOD production, FemED and GDPP are found to be significant explanatory variables in the model.

Table 2. Log-log estimation of relationship of IMR to total health expenditures as a share of GDP (1995-2013), Ethiopia

Variables	Coef.	Newey-West Std. Err.	t	P>t
lnTHE	-0.335	0.086	-3.880	0.003
lnGDPP	-0.394	0.083	-4.770	0.001
lnFemED	-0.149	0.053	-2.790	0.018
FOOD	-0.267	0.113	-2.360	0.038
INF	-0.001	0.001	-0.770	0.458
URBP	-0.015	0.014	-1.060	0.314
THE ²	0.037	0.010	3.510	0.005
Constant	7.927	0.281	28.190	0.000

Dependent variable is IMR

Note: ADF unit root test of lag (1) is $Z(t) = -4.030$, $P=0.001$. PP test for unit test of Newey-West lags (2) is $Z(t) = -4.217$, $P=0.001$.

In considering Model II, shown in table 3, the Newey-West estimator gives -34 as the coefficient estimate of THE on IMR which is strongly significant ($P=0.000$), suggesting that during the included time period of study, THE has got a strong significant effect on improving health status in the country under the study. Here again using both ADF ($Z(t) = -5.295$, $P=0.000$) and PP ($Z(t) = -3.211$, $P=0.019$) test, we reject the null hypothesis of the presence of a unit root in a residuals.

Explicitly, the estimation result indicates a 1% increase in total health expenditure as a % of GDP saves the life of 34 infants per 1000 live births.

Besides, the estimation result suggests that the effect of THE on IMR to have its optimal level beyond which marginal increase in THE may not result in similar change in reducing IMR. More specifically, from partial marginal analysis, after 4.44 with corresponding IMR of 54, the number of infant life saved start to decline though the effect of THE in reducing IMR continues. Note that the optimal level 4.44 stated here is close to the minimum recommended 5% by WHO¹⁶ (and also nearly similar to the indicated level in Fig 2). In our analysis we further account for a non-monotonic relationship between THE and growth in IMR decreasing by employing the square of THE (THE^2) in the specification and is significant ($P=0.000$) as indicated in Table 3.

Table 3.Semi-log estimation of relationship of IMR to total health expenditures as a share of GDP (1995-2013), Ethiopia

Variable	Coef.	Newey-West Std. Err.	t	P>t
THE	-34.379	4.810	-7.150	0.000
lnGDPP	-11.505	4.783	-2.410	0.035
lnFemED	-16.440	2.941	-5.590	0.000
FOOD	-24.048	5.818	-4.130	0.002
INF	-0.040	0.044	-0.920	0.379
URBP	0.258	0.884	0.290	0.776
THE ²	3.871	0.610	6.340	0.000
Constant	362.981	20.362	17.830	0.000

Dependent variable is IMR

Note: ADF unit root test of lag (1) is $Z(t) = -5.295$, $P=0.000$. PP test for unit root test of Newey-West lags (2) is $Z(t) = -3.211$, $P=0.019$.

Contrary to common wisdom, the estimation result indicates that THE and IMR relationship is not as such linear, rather it is quadratic or U shape. This can possibly explained by the fact that a reasonable change in THE has got substantial effect on high IMR given it is principally devoted to basic primary health care services in the country. However, the more the IMR get lower the less the effects of THEs on change in IMR. This might be due to the possible epidemiological transition from communicable diseases to non-communicable diseases, where communicable diseases are more amenable to changes in THE at the indicated optimal level. Another less likely explanation is, after the indicated optimal level, THE might compromises consumption of households that would otherwise contribute to the health improvement.

Conclusion and recommendation

The findings of the current study is in line with previous studies that found health expenditures as an important influencing explanatory variable of health outcomes.^{12-14, 29-31}

The results are as expected, the high proportion of total health expenditures are used to provide the basic primary health care services particularly in low income countries with high burden of communicable diseases that can be prevented and controlled at the lower compatible level of expenditures on health.

The policy implication of this study is, whilst, increasing health expenditure to levels that are compatible is recommended for further improvement of the health status in the country, advancing the progress of socioeconomic factors like food production and female education plays a pivotal role to achieve the nationally and internationally aspired Sustainable Development Goals.

The current study is limited however, with having enough time series observation for our variables which would have improved the results. While this limitation would be a ground work for future researches in this regard, it does not invalidate the current findings. We also feel that using different methodological approach in an effort to produce a more robust estimate of the marginal effect of the disaggregated public/government health expenditure and private health expenditure on health status is imperative.

References

1. ICSU, ISSC (2015) Review of the Sustainable Development Goals: The Science Perspective. Paris: International Council for Science (ICSU), <http://www.icsu.org/publications/reports-and-reviews/review-of-targets-for-the-sustainable-development-goals-the-science-perspective-2015/SDG-Report.pdf>, accessed 13 May 2016.
2. Hopkins, S. (2010) Health Expenditure Comparisons: Low, Middle and High Income Countries. *The Open Health Services and Policy Journal* 3: 111-117.
3. Jaunky, V.C.Khadaroo, A.J. (2008) HEALTH CARE EXPENDITURE AND GDP: AN AFRICAN PERSPECTIVE. *Applied Econometrics and International Development* 8(1): 131-146.
4. Filmer, D., & Pritchett, L. (1999) The impact of public spending on health: Does money matter? *Social Science and Medicine* 49:1309–1323.
5. Lopes, P. S. (2003) A comparative analysis of government social spending indicators and their correlation with social outcomes in Sub-Saharan Africa. *Health Policy* 65 (3) 277-99.
6. Riman, H.B., Bassey, J.U., Ibi, E.E., Edu, B.E. (2010) Poverty, Health Expenditure, and Health Status: a long term perspective with evidence from Nigeria. *European Journal of economics, finance and administrative sciences* 27,120
7. Lichtenberg, FR. (2004) Sources of US longevity increase, 1960–2001. *Quarterly Review of Economics and Finance* 44(3): 369-389.
8. Self, S., Grabowski, R. (2003) How effective is public health expenditure in improving overall health? A cross-country analysis. *Applied Economics* 35(7):835–845.
9. Aisa, R., Clemente, J., Pueyo, F. (2014) The influence of (public) health expenditure on longevity. *International Journal of Public Health* 59:867–875.
10. Gupta, S., Verhoeven, M., Tiongson, E. (2003) Public Spending on Health Care and the Poor. *Health Economics* 12(8):685-96.
11. Bokhari, FAS., Gai, Y., Gottret, P. (2007) Government health expenditures and health outcomes. *Health Economics* 16(3): 257-273.
12. Akinkugbe, O., & Mohanoe, M. (2009) Public health expenditure as a determinant of health status in Lesotho. *Social Work in Public Health* 24, 131–147.
13. Ssozy, J., Amlani, S. (2015) The Effectiveness of Health Expenditure on the Proximate and Ultimate Goals of Healthcare in Sub-Saharan Africa. *World Development* 76: 165-179.
14. Anyanwu, JC., & Erhijakpor, AEO. (2007) Health Expenditures and Health Outcomes in Africa. *African Development review* 21(2): 400-433.
15. Ethiopia Federal Ministry of Health (2014) Ethiopia's Fifth National Health Accounts 2010/2011. Addis Ababa, Ethiopia.

16. WHO.(2010b) The World Health Report: Health Systems Financing: The path to universal coverage,http://apps.who.int/iris/bitstream/10665/44371/1/9789241564021_eng.pdf,accessed May 13 2016
17. Central Statistical Authority [Ethiopia] and ORC Macro (2001) Ethiopia Demographic and Health Survey 2000. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Authority and ORC Macro
18. Central Statistical Agency [Ethiopia] and ORC Macro (2006) Ethiopia Demographic and Health Survey 2005. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ORC Macro.
19. Central Statistical Agency [Ethiopia] and ICF International (2012) Ethiopia Demographic and Health Survey 2011. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ICF International.
20. WHO, (2014) Ethiopia country cooperation strategy at a glance: http://www.who.int/countryfocus/cooperation_strategy/ccsbrief_eth_en.pdf?ua=1,accessed 14 May 2016.
21. Negeri, KG., Hailemariam,D. (2016) Effect of health development assistance on health status in Sub-Saharan Africa. *Risk Management and Health Policy* 9 (6): 33–42.
22. Gujarati, D.N. (2004) Basic Econometrics. The McGraw–Hill Companies.
23. Wooldridge,J.M. (2002) Introductory Econometrics: A Modern Approach.2E.Serial Correlation and Heteroskedasticity in Time Series Regressions. South-Western Publisher, pp.395-406.
24. Newey, W.K., and K.D. West. (1987) A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica*55 (3): 703–708.
25. Dickey, DA., Fuller, WA. (1981) Likelihood ratios for autoregressive time series.*Econometrica*49(4):1057–1172.
26. Phillips,PCB.,Perron, P. (1988) Testing for Unit Roots in Time Series Regression.*Biometrika*75(2):335–346.
27. World Bank, World Development Indicators: <http://data.worldbank.org/country/ethiopia>. Last accessed April 19, 2016.
28. Mishra, P., Newhouse, D,(2009) Does health aid matter? *Journal of Health Economics* 28:855–872.
29. Baldacci, E., Guin-Siu MT., & Mello L. (2003) More on the Effectiveness of Public Spending on Health Care and Education: A Covariance Structure Model. *Journal of International Development* 15, 709–725.
30. Cevic, S., Tasar,O. (2013)Public Spending on Health Care and health outcomes: cross-country comparison.*Journal of Business, Economics & Finance* 2 (4): 82-100.

31. Navignon, J., Olakojo,SA., and Nonvignon,J. (2012) The effects of public and private health care expenditure on health status in sub-Saharan Africa: new evidence from panel data analysis.*Health Economics Review* 2(22):1-8.

Acknowledgements

We are grateful to Addis Ababa University School of public health for enabling us conduct this research in the necessary resources.

We would also like to extend our gratitude to WB,WHO,CSA,MOFEC and FMOH for publically availing the data used in this study .

Appendix III: List of SSA included in the study

The list of 43 countries included in the study are: Angola, Benin, Botswana, Burkina Faso, Burundi , Cameroon, Central African Republic, Chad, Comoros, Congo, Dem. Rep. , Congo, Rep. ,Cote d'Ivoire, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, The , Ghana , Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali. Mauritania. Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda and Zambia.

13. Declaration page

Letter of Declaration

I, the undersigned, declared that this is my original work, has never been presented in this or any other University, and that all the resources and materials used for the thesis, have been fully acknowledged.

Name: Keneni GutemaNegeri

Signature: _____

Date: July 11,2016

Place: Addis Ababa

Date of submission: Date: July 11,2016

This dissertation has been submitted for examination with my approval as PhD Supervisor.

Name: Prof. Damen Hailemariam

Signature: _____

Date: July 11,2016