Does Development Assistance For Health Buy Better Results In Maternal Health in Tanzania? Evidence from Autoregressive Distributed Lag (ARDL) Model.

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Abstract

This paper establishes whether development assistance for health buy better results in maternal health in Tanzania using annual time series data for the period between 1995 and 2014 based on Autoregressive Distributed Lags (ARDL) and Error Correction Model. A long run cointegration relationship exists between GDP per capita, maternal mortality, unemployment and development assistance for health over examined period of time. The results show that in the long run Development Assistance for Health (DAH) and Economic growth (measured by real GDP per capita) was significant in reducing maternal mortality in Tanzania. In the short run, unemployment was statistically significant on increasing maternal mortality in Tanzania between 1995 and 2014. Furthermore, the short run results show that both DAH and real GDP per capita reduces maternal mortality between 1995 and 2014. The results imply that Development Assistance for Health (DAH) channeled to the health sector is an important component in improvements of maternal health in Tanzania. The findings are robust to sensitivity analyses and estimation methods.

Keywords: Maternal Mortality, DAH, Unemployment, Autoregressive Distributed Lags, ARDL

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1. Introduction

A good health is a key factor to human's economic progress due to its contribution in production (WHO Commission on Macroeconomics and Health, 2001). Health status of mothers, infants and children help to determine health status of the next generation and even to predict future public health challenges for families, communities and the health care system of a given community (Chung & Raman, 2007). Likewise, in order to improve the health of infants and children, it's important to start with maternal health. This is due to the fact that, healthy mothers lead to healthy children and therefore health generation (World Health Report, 2005).The whole world recognizes the importance of maternal health as far as public health concern, though maternal mortality has remained high indicating a number of problems on maternal health.

Globally, the estimates by the World Health Organization (WHO) showed the maternal mortality has fallen by around 44% between 1990 (i.e. 385 maternal deaths per 100,000 live births to 216 deaths per 100,000 live births) and 2015compared to the target of three quarter by 2015 (WHO, 2015). Furthermore, in developing regions maternal deaths continued to have a worse situation in 2015, accounting for approximately 99% compared with developed regions. For example, Sub-Saharan Africa continued to have the highest rate of 546 maternal deaths per 100,000 live births followed by Southern Asia with 176 maternal deaths per 100,000 live births while in developed regions it was around 23 maternal deaths per 100,000 live births (WHO, 2015). This shows that, maternal mortality was improved in the developed regions compared with developing regions. Several causes were identified for the results in the developed regions, among others; very low level of fertility and high levels of health care contributes on one hand. Although developing regions showed very high level of maternal mortality, there were variations from one region to another. For instance, Tanzania is among the countries in Sub-Saharan Africa, which experiences high maternal deaths. Maternal mortality decreased from 842 deaths per 100,000 live births in the year 2000 to 398 deaths per 100,000 live births in 2015, a decrease of 60.1% as opposed to 75% of the target which was not achieved (WDI, 2016).

Following the outgoing MDG Goals of reduced maternal mortality by three quarters (75%) in the year 2015, both developed and developing countries allocated significant portions of their budgets annually for health services, with intention of improving maternal health and other MDG goals. Developing countries received the massive support from the developed region in terms of development assistance for health (DAH). Hence, from the year 2000, development assistance for health started to scale up at a faster rate than before (IHME, 2012). For example, in Tanzania, DAH increased from 123.39 million US dollars in the year 2000 to 1108.67 million US dollars in 2013 (IHME, 2015). Development assistance for health (DAH) is defined as the financial assistance (including grants and concessionary loan provided with no interest or at a rate significantly lower than the current market rate) and in-kind assistance given by the global health channels to improve health in developing countries (IHME, 2015). Since there was a massive surge of DAH in developing countries including Tanzania, there is a need to assess whether DAH contributed to buy better maternal health despite the fact that Tanzania failed to achieve Millennium Development Goals (MDG) target of maternal mortality in 2015. This raises question of whether, the contribution of DAH are only limited to other healthy related goals or not? Are the resources for investment in maternal health sufficient? We are aware that, maternal mortality can be caused by many factors among them includes distance to hospital, home delivery and non-availability of blood, low level of education, poor antenatal care visits, lack of transport to health facility (Illahet al., 2013). The purpose of our study was to assess the impact of development assistance for health (DAH) towards improving maternal health in Tanzania using the autoregressive distributed lag (ARDL) model. It identify whether DAH contributes to the reduction of maternal mortality in Tanzania over the period between 1995 and 2014. We are aware that, this is the first study in Tanzania which updates the currently available information on DAH, and maternal health using ARDL approach to provide a useful knowledge for policy maker's regarding the allocation and impact of DAH on improvement of maternal health.

The rest of the paper is structured as follows. Section 2 deals with the literature reviews. Section 3 describes the methodology and data sources while section 4 presents the empirical results and discussion. Section 5 presents the conclusion and policy recommendations.

2. Literature Review

In the year 2000, the international community made a strong commitment towards poverty eradication by outgoing Millennium Development goals (MDGs). Due to insufficient resources in the developing region they marked a new move on development aids. Health being the focus of the outgoing MDGs, the provision of DAH attained a special attention. For example, official development assistance for health was estimated to have more than doubled, from $3,107 million in 1993 to $6 million in 2003 (MacKellar, 2005).

Based on the Big-Push theory by Rosenstein Rodan (1943), an investment package is important to bring economic development; or a certain minimum amount of resources must be devoted for development programmes if the successes of the programme are required. This can be justified as developing countries have fewer resources to invest in health; they are likely to suffer from a lot of weaknesses in their health sectors. Now, through massive support from developed countries in the form of DAH, developing countries will be capable of enhancing their health services. There are several empirical literature outlined the effect of DAH on health status in different countries. Among the previous studies that found positive and significant effects of aggregate aid on health outcomes include (Gyimah-Brempong, 2015; Arndt et al., 2014; Gormanee et al., 2005; Dalgaard & Hansen, 2001). For example, Gyimah-Brempong (2015) found that health aid significantly reduces the under-five mortality rate, maternal mortality rate, cholera mortality rate in African countries while increasing the ability to fight against other diseases like TB through both immunization and cure. He also found that, the improved health outcomes as a result of health aid become more effective when there is a high domestic expenditure on health and good governance. In addition to this, health aid has also been identified not only to decrease mortality alone, but also to increase life expectancy of the population of the receiving countries (Bendavid & Bhattacharya, 2014).

Unger et al. (2009) examined progress towards millennium development goal on maternal health in the global south found that, policies that make health care publicly funded have a greater impact on improving maternal and child health. This is only possible when either the government can raise sufficient revenue to invest in health service or through sufficient DAH from donors. A good example of this case can be traced from Rwanda in 2010. DAH enabled the provision of national health insurance to nearly 92% of the population through a scheme known as "Mutuais" covering major causes of morbidity and mortality, life expectancy increased with decrease in both maternal and mortality rate (Sridhar & Gostin, 2010). Developing countries depends on not only how much they spend on health, but also the amount of funds flowing to support health. A similar case is that of India whereby, being the largest recipient of external health funding, they managed to lower its maternal mortality from 570 deaths per 100,000 live births in 1990 to 174 deaths per 100,000 live births in 2015 by 69% although they failed to reach the MDGS's target, they achieved better result compared to other areas of developing regions. In addition to this, tracking the progress of outgoing MDGs in 2005, Sub-Saharan Africa indicated that, there was insufficient DAH leading to insufficient expenditure on health (Kabir, 2008). This result into significant shortage of health professionals due to inability of the region to train health workers sufficiently at a required amount and low payment that lead to migration of the scarce workforce to other areas (Gerein et al., 2006). In turn, it limited the range of appropriate health services in the region, hence poor progress to both maternal and child mortality.

As a result, the international community increased DAH to reach the agreed amount in order to improve progress towards the achievement of the outgoing MDGs targets. It should also be noted that, DAH does not always lead to improved health condition everywhere. It is of particular relevance to consider other aspects relating to how much external funding is being supplied, how the fund is being allocated and efficiency of the health system of the respective receiving authority (WHO, 2007). Considering, the case of Kenya in 2005, Sidze et al (2013) found that, donors increased funds for health, the percentage of it devoted to reproductive health decreased and hence led to stagnation in achieving a decreased maternal mortality target. Similarly, Magadi et al. (2003) found that, in the Sub-Saharan Africa, classes of people (i.e., the poor and the rich as well as urban and rural) show different results of maternal health. There might be more funds given to a poor community but rural dwellers are likely to benefit less than urban dwellers due to structural arrangements of the respective receiving country.

The same results was also found in USA where, despite the nation being rich and capable of affording high expenditure for health, maternal mortality remained high among the blacks compared to the whites to the extent of making USA behind the rest of the developed region in achieving the reduced maternal mortality target of the outgoing MDGs (United States, 1995). On the other hand, Mavalankar et al. (2009) using the rural India as an example found that, there were problems related to maternal health that cannot be solved by DAH alone. For example the problem of non-availability of blood in rural areas contributed to the stagnation of the reduction in maternal mortality target. Furthermore, Meyer and Buescher (1994) using the case of North Carolina noted that, high maternal mortality was highly related to abortion. That means, decreasing abortion-related mortality significantly reduced maternal mortality. Our paper contributes to the literature review by focusing on DAH using data from Tanzania and adopts an econometric estimation technique, the ARDL.

3. Methodology

3.1 Data Sources and Selection of the Variables.

Annual time series data on Development Assistance for Health (DAH) and two controlling variables, gross domestic product per capita (GDP per capita) and unemployment as a percentage of total labor force covered between 1995 and 2014 were used to measure its impact on maternal health. DAH was obtained from the Institute for Health Metrics and Evaluation (IHME) Database. DAH described on this paper includes assistance through both government and nongovernment channels. It is the annual amount of development assistance directed to the health sector in constant 2015 US dollars from all channel sources in a given year. Unemployment as a percentage of total labour force and GDP per capita was obtained from the World Bank Development Indicators Database (2016) published online by the World Bank. Maternal Mortality ratio was described as number of deaths per 100,000 live births. The real GDP per capita was used as proxy for economic growth and expressed in constant 2010 US dollars. Maternal mortality rate used in this study is one of the more popular measures of population health indicators (Okunade & Murthy, 2009). It is defined as the deaths of a woman while pregnant or within 42 days of termination of pregnancy.

3.2 Model Specification

Our model is based on previous empirical work (e.g., Bendavid & Bhattacharya, 201; Gyimah-Brempong, 2015) specified as follows:-

$$(\text{Health Outcome})_t = \text{f}(\text{ DAH}_t, \text{X}_t) \quad (1)$$

Where **Health outcome** represent the maternal mortality (MR) at a given period of time, X is a vector of controlled variables such as GDP per capita and unemployment (UNE) and ***t*** represents time, μ_t indicate the error term at given time.
In a linear form equation 1 is written as:

$$\text{MR}_t = \alpha_0 + \alpha_1\text{DAH}_t + \alpha_2\text{GDP}_t + \alpha_2\text{UNE}_t + \mu_t \quad (2)$$

The variables are converted into natural logarithm to describe the model coefficient as a degree of response for change of variable with respect to another. It also reduces heteroskedasticity, thus making normal distribution of the data with constant mean and variance. Therefore, equation 2 takes the following form:-

$$\text{LMR}_t = \alpha_0 + \alpha_1\text{LDAH}_t + \alpha_2\text{LGDP}_t + \alpha_3\text{LUNE}_t + \mu_t \quad (3)$$

Where **L** represent natural logarithm.

3.3 Model Estimation Techniques

In estimating the Autoregressive Distributed Lag (ARDL), the test involved the asymptotic critical value bounds, depending whether the variables are stationary at first difference, I(1) or stationary at level, I(0). Two sets of critical value are generated which one set refers to 1(1) series and the other for I(0) series. Critical values for I(1) series are referred to as upper bound critical values, while the critical values for I(0) series are referred to as lower bound critical values (Pesaran et al., 2001). The lower bound critical values assumed that the explanatory variables are integrated of order zero I(0) while the upper bound assumes that, explanatory variables are integrated of order one I(1). The advantages of ARDL approach are many, among them are; different variables have different optimal numbers of lags. The endogeneity problem does not arise in the ARDL modeling when estimating both the short run and long run coefficients simultaneously with lagged dependent and explanatory variables. Moreover, the ARDL coefficients estimates are super-consistent even for small samples. The error-correction

modeling through the ARDL cointegration procedure facilitates both the short run model (See for example, Pesaran and Shin, 1999; Pesaran et al., 2001).
In order to test for cointegration using bounds testing procedure, the ARDL representation of Development Assistance for Health (DAH), GDP per capita (GDP) and Unemployment (UNE) on maternal mortality (MR) were given as:

$$\Delta \mathrm{L(MR)}_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} \Delta \mathrm{L(MR)}_{t-i} + \sum_{i=0}^{q} \alpha_{2i} \Delta \mathrm{L(DAH)}_{t-i} + \sum_{i=0}^{q} \alpha_{3i} \Delta \mathrm{(GDP)}_{t-i} + \sum_{i=0}^{q} \alpha_{4i} \Delta \mathrm{(UNE)}_{t-i} + \lambda_1 \mathrm{L}(MR)_{t-1} + \lambda_2 \mathrm{L(DAH)}_{t-1} + \lambda_3 \mathrm{L(GDP)}_{t-1} + \lambda_4 \mathrm{L(UNE)}_{t-1} + \mu_t \quad (4).$$

Where Δ denotes the first difference operator, L is the natural logarithm and q is the optimal lag length. The left hand side of the equation is the dependent variable while the right hand side is the explanatory variables. The first until third expressions ($\boldsymbol{\lambda_1 - \lambda_4}$) on the right-hand side correspond to the long-run relationship. The remaining expressions with the summation sign($\boldsymbol{\alpha_1 - \alpha_4}$) represent the short-run dynamics of the model. $\boldsymbol{\mu_t}$ represent the error term. The null and alternative hypotheses tested between the examined variables are:-

HO: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$ means no cointegration relationship between the variables or (no long-run relationship)

H1:$\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 = 0$ means cointegration relationship between the variables or (a long-run relationship exist)

If cointegration exists, the long run and short run model is estimated. The short run model is shown as follows**:**

$$\Delta \mathrm{L(MR)}_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} \Delta \mathrm{L(MR)}_{t-i} + \sum_{i=0}^{q} \alpha_{2i} \Delta \mathrm{L(DAH)}_{t-i} + \sum_{i=0}^{q} \alpha_{3i} \Delta \mathrm{L(GDP)}_{t-i} + \sum_{i=0}^{q} \alpha_{4i} \Delta \mathrm{L(UNE)}_{t-i} + \gamma ECM_{t-1} + \mu_t \quad (5)$$

Whereas γ is the coefficient of the error correction term. Equation 5 is the ARDL short run specification derived from the formulation of error correction term (**ECM**). The ECM represents the speed at which the dependent variable adjusts to equilibrium as a result of shocks. It must be negative and statistically significant to show that there is an adjustment to equilibrium. For valid results, the model must pass through diagnostic tests.

4. Empirical findings and Discussion

Table 1 summarizes descriptive statistics of variables before their transformation into logarithms. Transformation of the data into logarithms makes more linear and normal distribution.

Table 1: Summary of Statistics of Variables

Variables	Description	Mean	Std Deviation
MR	Maternal Mortality ratio (per 100,000 live births)	693.4	181.6
GDP	Real Gross Domestic Product per capita (constant 2010 US dollars)	$ 606.5	$115.7
DAH	Development Assistance for Health (constant 2015 US dollars)	$ 4.71 Millions	$ 3.72 Millions
UNE	Unemployment as a percentage of total labour force	3.7%	1%

Source: Authors estimation, 2017

4.1 Results of Unit Root Test

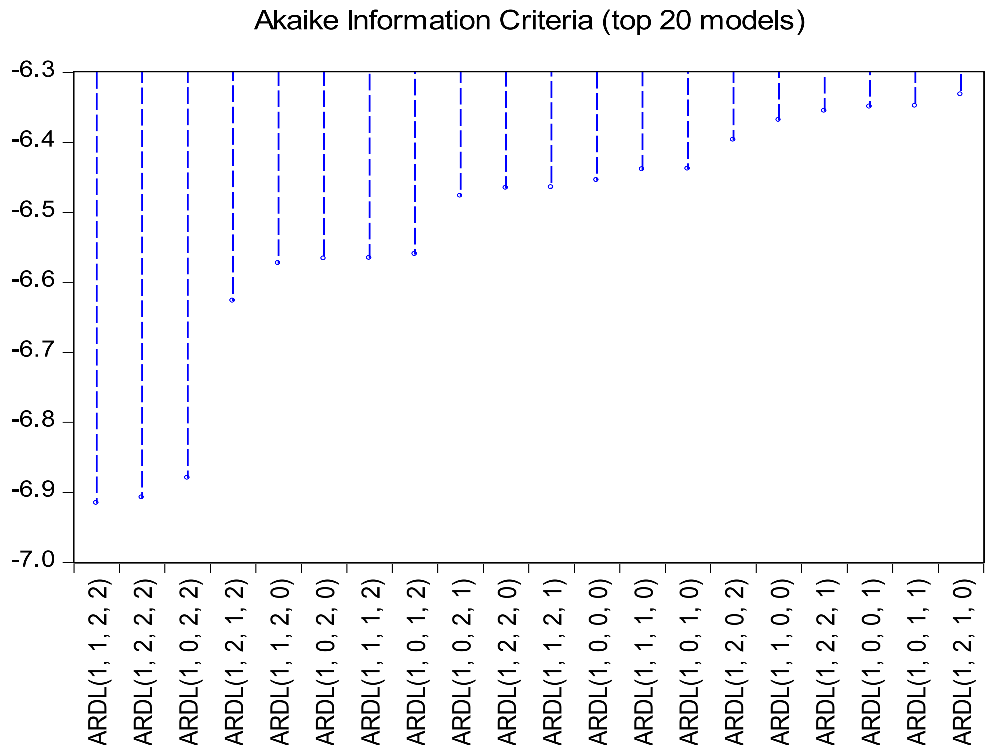
If the variables are non-stationary, the assumption of OLS became inconsistency and bias. Most of time series data are non-stationary and using non-stationary data lead to spurious regression. We used the Dickey Fuller (DF-GLS) and Augmented Dickey Fuller (ADF) unit root test to determine the stationarity of variables. The unit roots tests for GDP per capita, DAH and unemployment (UNE) are run with constant and trend. Maternal mortality (MR) was stationary in levels without trend and constant. The selection of the lag length was determined by Schwartz Information Criteria (SIC). The unit root results are reported in Table 2.

Table 2: Unit Roots (non-stationary) Test

	ADF		DF-GLS		Order of Integration
Variables	**At level**	**1st Difference**	**At level**	**1st Difference**	
LGDP	-5.48***	-3.6	-3.89***	-2.68	I (0)
LDAH	-3.35	-8.32***	-3.61	- 8.07***	I (1)
LMR	-2.32**	-0.14	-1.83*	2.065**	I (0)
LUNE	-3.15	-7.23***	-3.35	-7.66***	I(1)

Source:(Author's Analysis, 2017), ***= P value statistically at 1% critical values and P < 0.001; **= P value statistically at 5% critical value, *= P value statistically at 10% critical value. I(0)= stationary at level, I(1)= Stationary at first difference.

Following Pesaran et al. (2001), the validations of bound test is to allow a mixture of I(0) and I(1) variables as regressors. The major violation of ARDL approach occurs when the variables are stationary at second difference, I(2). Therefore, we conducted unit root test to make sure that no variables are stationary at I(2). From table 2, the variables are combination of I(0) and I(1), meaning that the ARDL approach to cointegration satisfy the conditions. Based on equation 4, the maximum lags for selected ARDL model approach to cointegration is (1, 1, 2, 2), selected automatically by AIC (Akaike Information Criteria) out of top 20 models as shown in Figure 1. Figure 1 shows that, the lower value of AIC is -6.9, hence the better the model.



Source: Authors Estimation using Eviews 9.

After lag length selection, the autoregressive distributed lag (ARDL) or bound test was conducted. The result of the bound test is shown in Table 3.

Table 3: ARDL Bound Test

Null Hypothesis: No long run relationship exist		
Test Statistic	**Value**	**k**
F- Statistics	11.44	**3**
Critical value bound		
Significance	Lower Bound, I(0)	Upper Bound I(1)
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

Source: Authors estimation in Eviews 9.
K= Number of explanatory variables.

The F-test in Table 3 is used to test if cointegration exists between the variables. The computed F- test statistics is compared to the critical values bound. If the computed F- Statistics is above the upper bound, the null hypothesis of no cointegration is rejected and if it is below the lower bound the null hypothesis is not rejected. Moreover, if the F- Statistics is between the upper and the lower bound, the results are inconclusive about cointegration (Pesaran et al, 2001). Therefore, the computed F statistics for the Bound test is 11.44 which are greater than the upper bound critical values at 10%, 5%, 2.5%, 1% significance levels using unrestricted intercept and no trend (See Table 3). We strongly reject the null hypothesis of no long run relationship. The bound test shows the existence of cointegration or long run relationship among the variables. After existence of cointegration, both long run and short run model of ARDL are estimated.

Table 4 shows the short run and long run model of ARDL represented in equations 5 and 4 respectively.

Table 4: Short run and Long run results of ARDL

A: Short run model				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Probability**
D(LGDP)	-0.51	0.17	-2.91	0.02**
D(LDAH)	-0.02	0.01	-1.86	0.10
D(LDAH(-1))	-0.02	0.01	2.16	0.06*
D(LUNE)	0.003	0.01	0.29	0.80
D(LUNE(-1))	0.02	0.01	2.46	0.04**
$\mathbf{ECM_{t-1}}$	-0.32	0.09	-3.56	0.01**
B: Long run model				
LGDP	-0.78	0.24	-3.16	0.01**
LDAH	-0.19	0.06	-3.49	0.01**
LUNE	-0.07	0.04	-1.53	0.16
Constant	15.28	0.63	24.33	<0.001***
D: Diagnostic Tests				
Breusch-Godfrey Serial Correlation LM Test				0.21
Heteroskedasticity Test				0.70

Note: ***= P value statistically at 1% critical values and P < 0.001; **= P value statistically at 5%, *= p value statistically at 10%.

From Table 4, the short run model shows that both DAH and GDP per capita significantly reduces maternal mortality over time in Tanzania. Likewise in the short run, a lagged unemployment as a percentage of total labour force increases maternal mortality. An increase of unemployment increases maternal mortality by 2%. Thus, the effect of increased unemployment is substantial increases in mortality (Brenner, 2005). The mechanism through which maternal mortality relate to changes in unemployment persist after initial periods of unemployment rises. For instance, job loss (withdrawal from the labor force) has been associated with high levels of psychological problems and harmful behaviours, which can arise and reduce access to health care through an inability to pay for transport due to loss of income. Therefore, increases in unemployment in the short run lead to increases in maternal mortality.

In the long run model, both GDP per capita and Development Assistance for Health (DAH) significantly reduces maternal mortality. The diagnostic test shows the model to be free with autocorrelation and heteroskedasticity problem. The coefficient of error correction term (**ECM**) is negative (-0.32) as expected and statistically significant at 0.007 p - value.

$$LMR = -0.78*GDP -0.19*LDAH -0.07*LUNE + 15.27 \quad (6).$$

The above equation is derived from the long run relationship model. A 10% increase in real GDP per capita results in long run decrease of maternal mortality by 78%. Therefore, an increase in individual income (GDP per capita) leads to reduction of maternal mortality. Similarly, a 10% increase in development assistance for health reduces maternal mortality by 19%. The finding shows that, GDP per capita and DAH remains significantly associated with declines of maternal mortality between 1995 and 2014. Over ally, economic changes have an effect on maternal health.

The impact of DAH on health outcomes is higher at lower income levels than at higher incomes, thus being for pro-poor (Arndt et al., 2014; Gormanee et al., 2005). This means, DAH benefits the poor more than it does for the reach (Bendavid, 2014). The mechanisms through which the increases of DAH are associated with the reductions of maternal mortality are not widely discussed in the literature. However, we propose a number of mechanisms through which this might occur. Firstly, the expenditures on maternal health cover a range of facilities and services from family planning, abortion care, to obstetric care at delivery. Therefore, increased DAH may lead to increased provision of high quality services in one or more of these areas. Hence, reduced DAH can increase maternal mortality. Secondly, DAH can be used in training of physician and midwives to manage uncomplicated and complicated pregnancies, childbirth and the postnatal period (WHO et al., 2004). Our study findings are similar to earlier research that found health aid significantly improves health outcomes in developing countries (Arndt et al., 2014; Gyimah-Brempong, 2015; Bendavid & Bhattacharya, 2009; Feeney & Quattara, 2013, Taylor et al., 2013, among others). Figure 2 and 3 shows the declines of maternal mortality that corresponds with the increase of DAH respectively.

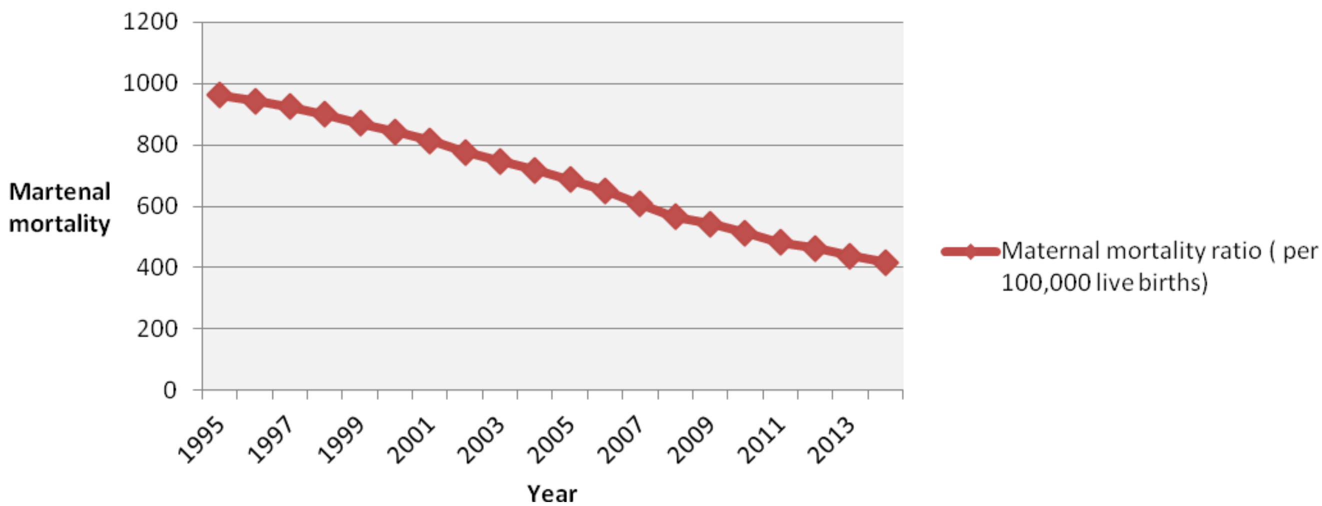


Figure 2: Maternal Mortality Ratio in Tanzania from 1995-2014

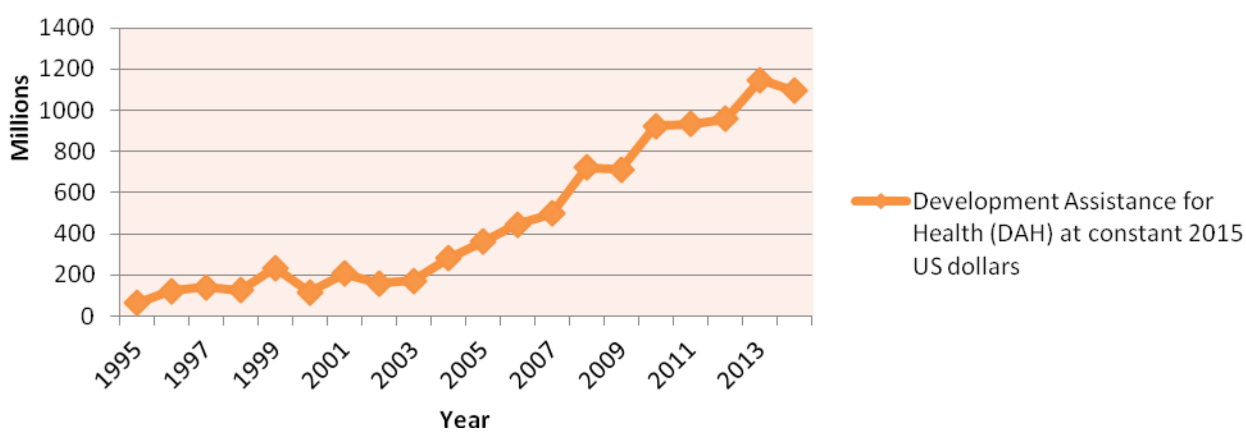


Figure 3: Development Assistance for Health Channeled into Health Sector in Tanzania (1995-2014).

5. Conclusion

Our paper describes whether development assistance for health (DAH) channeled to health sector can buy better maternal health in Tanzania. We found that DAH and real GDP per capita significantly buy better results on improving maternal health in Tanzania. Furthermore, in short run we found that unemployment as a percentage of total labour force leads to increased maternal mortality in Tanzania. Our findings are robust and subject to model specification. For further progress on maternal health in Tanzania, donors should continue to be committed on increasing DAH into the health sector. Furthermore, we need policies supporting to reduce unemployment which increases maternal mortality in Tanzania.

Our study has its own limitations. The availability of data on DAH limits the choice of sample period from 1995 to 2014. The study was specifically focusing on macro impact of aggregate DAH on health outcomes (maternal mortality) not on other indicators such as life expectancy, infant and under-five mortality in Tanzania. Finally, our results are not generalized to other countries apart from Tanzania and do not depend on the effectiveness and types of DAH. We suggest future studies to focus on effects of DAH on other indicators and further specific diseases such as Malaria, HIV/AIDS, and Tuberculosis which attracts a large inflow of health aids in Tanzania.

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