Effect of Health Expenditure on per capita GDP Growth in Developing Countries

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This paper examines the relationship between health expenditure and per capita Gross Domestic Product (GDP) growth in developing countries. The paper further explores whether the impact of health expenditure is different for developing countries as a whole compared with countries in Sub-Saharan Africa. Using the Solow growth model, panel data, and the 'system' GMM estimator, I find that economic growth in developing countries, after controlling for other factors is influenced by health expenditure, but the magnitude is slightly higher for SSA. The paper contributes to the literature by addressing the importance of health policies on economic growth in developing countries.

INTRODUCTION

This paper investigates the causal impact of an increase in health expenditure on per capita GDP growth in developing countries, and evaluate if the impact differs from countries in Sub-Saharan Africa (SSA). This is an important topic because health expenditures in developing countries are rising, but so have the costs of health services. Are there still sufficient incentives on efficiency grounds for additional investment in health services that could have a positive impact on economic growth? This study will contribute to the growing literature on the effect of health expenditure and economic growth, because previous studies that are based on panel data considered the fixed effects or random effects estimator of the effect of health expenditure in only one country (Odubunii et al, 2012; Serder, 2015; and Serap, 2016). While these methods may help us to understand some unknown facts about the impact of health on economic growth, they may not provide enough evidence on economic growth. Gyimah-Brempong and Wilson (2004) used the expanded Solow growth model and dynamic panel estimator to examine the effects of investment in health human capital on the growth rate of per capita income in SSA countries and the Organization for Economic Co-operation and Development (OECD) countries, and they found that after controlling for other variables, the growth rate of per capita income is positively influenced by investment in healthy human capital for both SSA countries and OECD countries. This study investigates the impact of investment in health on per capita GDP growth in countries within the same income characterization (developing countries) and determine if the impact is different for SSA countries. I estimate a dynamic panel model where I interact the level of health expenditure with developing countries and SSA country's average. My empirical analyses utilize a panel data of 139 countries over the period 1975 – 2015. I use the 'system' General Method of Moments (GMM) estimator proposed by Blundell and Bond (1998) to analyze my data, because it provides more efficient results. My findings show that the health expenditure impact per capita GDP growth positively for all developing countries; however, the magnitude of the impact when I consider a sub-sample, SSA average is slightly higher than the rest of

developing countries. My results are robust, when I consider the endogeneity of health expenditure and per capita GDP growth, and control for education and labor force participation. I find that system GMM approach may well provide better understanding about the effect of health expenditure on economic growth for policy change in the sample under study. The rest of the paper is as follows: Section 2 gives a brief background of the study. Section 3 describes the data and variables. Section 4 discusses the method used in analyzing the data, while Section 5 presents the results, and Section 6 is the conclusion.

BRIEF BACKGROUND

It is a fact that poor health makes one susceptible to diseases, thus reduces one's participation on the job; particularly, in the agricultural sector in the case of developing countries, where the majority of the workforce is involved in agricultural products. This may result in low productivity and output. Therefore, this paper can potentially contribute to the understanding of human capital through better health as part of the growth engine for Growth Domestic Product (GDP) in developing countries. Furthermore, the effects of communicable diseases like tuberculosis (TB), malaria and diarrhea are the top three illnesses affecting many people in developing countries, especially in SSA because of the low investment in public health expenditure (WHO, 2015). This contributes to a decline in productivity, because of loss of working days, which have damaging effects on the economy. Recent data on the TB case detection rate as a percent of all forms in SSA increased from 47% in 2005 to 51% in 2013 (World Bank, 2015). Although it is good news that the detection rate has increased over the years, the sad news is that SSA countries do not have the necessary health care systems required to reduce or eliminate TB in the region.

HIV/AIDS mortality is another health issue that inflicts about 5.8% adult population aged 14 to 49 (potential labor force) in SSA (Kahende, 2001). SSA countries constituted the most affected region, with nearly 24.7 million people living with HIV in 2013 comprising 71% of all people living with HIV in the world. Additionally, 240,000 children live with AIDS and the majority of these children live in SSA. However, the sub-region has only 1.3% of global health workers (WHO, 2015). Also, HIV/AIDS does not only affect the health of individuals, but its mortality impacts households, communities, and reduces economic growth in the long-run (Bloom and Canning, 2008). This is disturbing for SSA because these children are the future labor force of the region, which cannot be replaced by the elderly who become custodians of HIV orphans. This buttress Bell et al. (2004) argument that the creation of a generation of AIDS orphans has the potential to reduce care and education of children and low productivity in the future.

Poor health does not only apply to developing countries economic well-being, but it is a global issue. People in developing countries serve as consumers of the world market; whereby their offspring will one day contribute to the stream of innovative ideas, or remain on the sideline as utilized human potential. Also, because of low levels of health expenditure as a percent of per capita GDP in developing countries, communicable diseases such as TB and diarrhea, which recognize no borders, remain an ever-emerging threat to those in developed countries, as much as they do in developing countries. Therefore, the need to expand health expenditure in developing countries may prove universally beneficial.

Public health care expenditure declines when the size of the government, relative to the size of the economy falls (Wang et. al, 2016; Van der Gaag and Barham, 1998). Also, Fazaeli et al. (2016) argue that investment in health as a percent of GDP in developed countries is often larger than that of developing countries, implying that as the level of economic growth increases, health expenditure increases as well. Other studies, including Appiah & McMahon (2002), and Cervellati & Sunde (2002) found that long term investment in education and effective fiscal policies generate more output, which improve standards of living causing further investments in healthy human capital thus increase economic growth. Shultz (1999) also recognized low levels of health investments as a major human capital constraint that has had significant impact on slowing development in Africa in recent decades.

Despite the distressing health statistics in the sub-region, the region's total health expenditure as a percent of GDP continues to fall. It fell from its high of 6.5% in 2004 to 5.6% to 2008% and slightly

increased to 6.2 in 2009, and then continued to fall in subsequent years, reaching its current low of 5.9% in 2014 (World Bank, 2015). Public health expenditure as a percent of GDP has also not been consistent over the years. It dropped from 2.8% in 2009 to 2.5% in 2014.

Although, capital and land are the necessary components of GDP, labor is the essential factor under observation. Many SSA countries are endowed with diverse, rich natural resources and raw materials such as minerals and agricultural products that could be used efficiently to produce greater levels of output if an improved labor force was formed. Human capital development is one such method, which concerns itself with increasing productivity through better health and other means, with the goal of improved quality of life. A healthy and productive labor force is estimated to correlate with economic growth. This supposition is evidenced in developed countries, where higher labor productivity can be attributed to the increased public and private health expenditures; hence, a healthy labor force and sound economic policies are estimated to positively impact economic growth (Arora, 2002). This prediction draws upon previous studies that investigated the effects of health on economic growth rates and concluded that a healthy labor force, ceteris paribus is more productive, which is an important ingredient for maintaining higher levels of GDP (Bennell, 2005; Bhargava et. al, 2001). Bhargava et al. using a panel data found a positive, but weak relationship between health and economic growth.

Even though the developed world progress might not serve as a roadmap for SSA countries, it clearly shows a positive correlation between healthy populace and economic growth. The next section presents data utilized for this study. Table 1 shows that total health expenditure by OECD countries has been increasing over the past decades, while that of SSA countries' average with the exception of 2010 are relatively low. These health investments can in part explain the high per capita GDP in OECD countries and low per capita GDP in SSA countries.

TABLE 1
SUB-SAHARAN AFRICAN COUNTRIES (AVERAGE) AND OECD COUNTRIES HEALTH EXPENDITURES AND PER CAPITA GDP

	Total expenditure on health as % of GDP					**Per capita GDP (constant 2005 US$)**				
	1995	**2000**	**2005**	**2010**	**2014**	**1995**	**2000**	**2005**	**2010**	**2014**
SSA	4.9	5.0	5.6	6.0	5.9	1,480	1,695	2,096	2,343	2,621
Australia	7.3	8.1	8.4	9.0	9.4	38,038	44,176	48,656	51,845	54,240
Canada	8.9	8.7	9.6	11.2	10.4	37,568	43,637	47,180	47,446	50,065
Denmark	8.1	8.7	9.8	11.1		49,123	55,850	58,792	58,788	
France	10.1	9.8	10.6	11.2	11.5	34,147	38,524	40,319	40,706	41,345
Germany	9.4	10.1	10.5	11.2	11.3	34,784	38,000	38,971	41,788	44,877
Japan	6.6	7.5	8.2	9.6	10.2	40,368	42,169	44,393	44,507	46,519
Sweden	8.0	8.2	9.0	9.5	11.9	37,687	44,694	49,996	52,076	53,562
UK	7.0	7.0	8.2	9.5	9.3	30,599	35,250	39,491	38,708	40,620
USA	13.1	13.1	15.1	17.0	17.1	38,678	45,056	48,755	48,374	50,728

Source: World Development Indicators, The World Bank, 2016.

THE DATA

My statistical analyses use panel data of 139 developing countries over the period 1975 – 2015. I used the World Development Indicators (WDI) data from the World Bank (2017). My dependent variable is the log of per capita GDP growth (annual %). The variable of interest is total health expenditure as percent of GDP, because to increase growth of per capita GDP, it is important to have a labor force with human capital skills that can be acquired through education and better health. A healthy labor force increases productivity level ceteris paribus. Following the literature on the effect of health on economic growth, I include the following variables in my regressions. I employ total labor force participation rate (% of total population ages 15+) as a measure of the effect of health expenditure on the quality of labor. Following Appiah and McMahon (2002), Gyimah-brempong (2004), Schultz (1999), and McMahon (2002), I use data on education because all else equal, educated populace can be easily retrained thereby improve on human capital, which is estimated to make a positive contribution to economic growth. I use gross primary education because not all developing countries have attained universal secondary education. However, most of the developing countries have at least reached universal primary education. The following table is the summary statistics of my datasets, which consist of a total of 139 developing countries, out of which comprise 91 developing countries excluding SSA countries, followed by 48 countries in SSA.

TABLE 2
SUMMARY STATISTICS OF THE DATA

Variable	Label	Developing countries		Developing countries excluding SSA		Only countries in Sub-Saharan Africa	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
(1)	(2)	(3)		(4)		(5)	
GDP per capita growth (annul %)	Lgdppcgr	2.89	4.80	3.23	4.69	2.27	4.93
Total health expenditure (%GDP)	hex	2.83	1.48	3.02	1.54	2.49	1.28
Total labor force (% of 15+)	lft	64.35	11.36	61.08	9.76	70.28	11.66
Primary school enrolment	ger1total	100.99	19.12	104.78	13.42	94.11	25.09

Note. No. of countries: all developing, 139; developing excluding SSA, 91; Only SSA, 48. Time: 1975-2015. GDP per capita growth is annual percentage growth rate of GDP per capita, aggregate based on constant 2010 U.S. dollars. Total health expenditure is the sum of public and private health expenditure covering the provision of health services, but does not include provision of water and sanitation. Total labor force participation rate is the proportion of the population ages 15 and older that is economically active. Gross primary education (total no. of pupils enrolled at primary level in public and private schools.

MODEL

I apply the Keynesian modeling framework which hypothesizes that an expansion in government spending stimulates economic growth. Although this theory is not favored by some policy makers, others still believe that increases in government spending have a positive effect on economic growth; therefore, a

higher level of government spending on health is a decisive determinant of economic growth in developing countries. Based on this and the neoclassical growth model, I specify the growth of per capita GDP equation as:

$$У = AF (K, L) \quad (1)$$

where У represents per capita GDP growth; K is the share of per capita GDP growth; L describes the amount of labor; and A represents technology. However, due to the relationship between labor and technology represented by efficiency factor, the model is rewritten as:

$$У = F (K, AL) \quad (2)$$

Equation 2 indicates that an increase in any one of these variables, allow me to see how it would affect economic growth. The stock of capital is an adequate investment in health; hence, I proxy K variable with health expenditure (hex). Therefore, health expenditure and improved labor force (lft) can be combined to produce final goods and services. Thus, I specify the production function as the following:

$$У = f (hex, lft, X) \quad (3)$$

where per capita GDP growth (У) is a function of health expenditure (hex), labor force (lft), and X is a vector of controlled variables including education and SSA dummy that previous studies have shown to influence economic growth, and they are strictly exogenous. I introduce health expenditure in a quadratic form to examine the hypothesis proposed by Schultz (1999) that the marginal effect of per capita GDP growth is positive, but diminishing as health expenditure increases. I also introduce an interaction term, health expenditure and Sub-Saharan Africa (hex x ssa) to determine whether the interaction effect of policy change of health expenditure on economic growth in SSA countries is different from that of other developing countries as a whole. The following model examines the impact of the level of health expenditure on per capita GDP growth in a panel of 139 countries for 41 years (1975 – 2015):

$$Lgdppcgr_{it} = \alpha Lgdppcgr_{i,\,t-1} + \theta_1 hex_{it-1} + \theta_2 hex^2_{it-1} + \phi lft_{it-1} + \square ger_{1it} + \beta_1 saa + \beta_2 hex \times ssa + \mu_{it} \quad (4)$$

$$\mu_{it} = e_{it} + v_{it}$$

where i is the indexes for observational units, and it is the indexes for time. $Lgdppdgr_{it}$ is the log of per capita GDP growth as a percent of GDP and $Lgdppcgr_{it-1}$ is its lagged value. hex_{it} is health expenditure as a percent of GDP, lft_{it} is labor force and ger_1 is gross primary enrollment rate. In estimating the model, I include a lag to the independent variables assumed to be unrelated to μ_{it}. To improve the findings in the paper, I include a quadratic term for health (hex^2). Health expenditure (hex_{it}) and per capita GDP growth ($gdppcgr_{it}$) are assumed to be endogenous, because an increase in health expenditure (hex) has the potential to improve labor force's (human capital) productivity; hence, expand per capita GDP growth and vice versa. The regressors may be correlated with the disturbance term (μ_{it}), which consists of the unobserved country specific effects, $v_{i,}$ and the observation specific effect, e_{it} as shown in Equation (4).

One way to cope with the above problem is by employing the Arellano – Bond (1991) two-step difference GMM estimator first proposed by Holtz-Eakin, Newey and Rosen (1988) designed for small T and large – panels to investigate the effect of total health expenditures on per capita GDP growth. The Arrelano - Bond two-step GMM estimator estimates the covariance matrix of moment conditions using the first-step residuals which will make the endogenous variables to be pre-determined, hence not correlated with the residual in equation (4). However, the presence of the lagged dependent variable, $gdppcgr_{it-1}$ can potentially cause autocorrelation. To deal with this problem, the regressors are transformed by first differencing to remove the fixed country-specific effect (Arrelano – Bond, 1991). So, from equation (4), I get:

$$\Delta lngdppcgr_{it} = \alpha\Delta lngdppcgr_{i,\,t-1} + \theta_1\Delta hex_{it-1} + \theta_2\Delta hex^2_{it-1} + \phi\Delta lft_{it-1} + \Delta ger_{1it} \quad (5)$$
$$+ \beta_1\Delta saa + \beta_2\Delta hex \times ssa + \Delta\mu_{it}$$
$$\Delta\mu_{it} = \Delta v_i + \Delta e_{it}$$

where the variables are as defined above, and SSA (ssa) countries as a dummy variable and an interaction term health expenditure and SSA (hex x ssa). I assume that (Δlft) depends on the level of health expenditure and its efficiency on labor. So, all other things being equal, healthy labor force is:

$$lf_t = \Delta hex, \text{ where } \Delta hex = \lambda У_{hex} У \quad (6)$$

where λ is the product of the proportion of per capita GDP growth (У) devoted to health, and the level of (У), and healthy labor force depends on Δhex, and Δhex in equation (5) is given as: λ = λ(hex). By substituting λ into the Δhex equation, and then into the output function yields the implied economic growth equation as:

$$У = У(\Delta lft, \Delta hex, K) \quad (7)$$
$$\Delta lft = lft(\Delta Y, \Delta hex)$$
$$\Delta hex = hex(\Delta Y, \Delta lft)$$

Healthy labor force is determined by the level of health expenditure, which is also determined by per capita GDP growth; therefore, Δhex is endogenous. Hence, I make Δlft as a function of Δhex, and vice versa as shown above. K is a vector of controlled variables.

Hypotheses

I hypothesize that expansionary change in health expenditure (Δhex) has a positive effect on per capita GDP growth (У). I hypothesize that the difference between change in hex and hex^2 is positive. I also hypothesize that health expenditure may increase productivity of labor; therefore, Δlft has a positive effect on per capita GDP growth (У). Previous studies have shown that education improves human capital, hence productivity. Therefore, education is expected to have a positive effect on per capita GDP growth in developing countries.

ESTIMATION PROCEDURE

A potential problem that may arise from using Arellano – Bond difference GMM estimator is that if $E[X_{ij}\,\varepsilon_{is}] = 0$ for $j \leq t$ but allows $E[X_{ij}\varepsilon_{it}] \neq 0$ for $j \geq t$, then the variables are said to be predetermined (Drukker, 2008). For example, an increase in per capita GDP growth today caused an increase in health expenditures tomorrow. So, Arellano and Bover (1995) pointed out that when the variables are predetermined, the lagged levels of the regressors (X_{it}) are poor instruments for the first-differenced regressors, because the whole vector of differences of observed X_{it} cannot be included in the instrument matrix (ibid).

Blundell and Bond (1998) proposed a more efficient estimator, the system GMM estimator, which was developed from the work of Arrelano and Bover (1995). Their approach alleviates the poor instruments problem by using additional moment conditions. According to Drukker (2008), the system GMM estimator assumes that no autocorrelation exists and the initial condition that the panel level effect is uncorrelated with the first difference of the dependent variable. So, the system estimator approach fits well with dynamic panel-data estimators, and thereby provides useful background for my study. Based on this analysis, I use the two-step system GMM estimator to analyze my data, because of the superior performance of the system GMM estimator relative to difference GMM estimator in terms of finite sample bias and root-mean-square error (rmse) (see Bun & Windmeijer, 2009). I use the parameters (α, θ_1, θ_2, ϕ, □, β_1, β_2,) of the system GMM estimator for my analyses.

While the difference estimator is perceived as 'poor' instruments, the drawback of the system GMM estimator is that it uses 'too many' instruments, which also pose a problem (Hayakawa. 2007). As evidenced in Bobba and Coviello (2007), both difference estimator and system estimator yield different results.

RESULTS

I present the descriptive statistics for the data, followed by the empirical results from the 'system' GMM estimator to determine the effect of health expenditure on per capita GDP growth in developing countries. Also, I examine if the effects differ from that of SSA countries.

Descriptive statistics

The summary statistics presented in Table 2 includes the average annual growth rate of per capita GDP, total health expenditure as percent of GDP, total labor force participation rate (% of the total population from ages 15+), and total primary school enrollment (% of gross) in developing countries. Column 3 shows the statistics for all developing countries, while column 4 presents data for developing countries excluding SSA. Column 5 exhibits the data for only SSA countries. The data show that the proportion of GDP devoted to total health expenditure is lower in SSA countries than in other developing countries. As expected, gross primary enrollment is lower in SSA than developing countries as a whole. This suggests that some countries in SSA have not attained universal primary education. This could partly be explained by the low levels of investment in health expenditure; hence, low level of human capital, thus contributed to the depressing per capita GDP in the sub-region. However, the mean of the total labor force participation in SSA is slightly higher than that of developing countries as whole. This is consistent with the data (not shown) that shows an upward trend of the labor force participation rate in SSA. Though, the labor force participation rate is high, the productivity level is low, due to the low levels of investment in health and education. These factors are important contributors of human capital.

Empirical Results

First, I address the outcomes in a linear form followed by the non-linear and the marginal effect of total health expenditures on per capita GDP growth in developing countries based on the following questions:

(a) Does an increase in total health expenditures have a causal impact on developing countries per capita GDP growth?

One can argue that the relationship between better health and economic growth is not only because of the positive income effect, but that better health itself is an important determinant of per capita GDP growth. System GMM takes care of this endogeneity problem. I use the parameters of the system GMM from the equation (5) without the interaction term (hex x ssa) to investigate whether health expenditure policy has direct and indirect effects on per capita GDP growth. The parameter of interest is the coefficient (θ) of hex. The estimated values α, θ_1, θ_2, ϕ, □, β_1, and β_2, are as shown in Table 3. The test statistics suggest that the null hypothesis be rejected on the basis that variation in the dependent variable cannot be explained by variation in all the explanatory variables at ρ =.01. The test statistics show the absence of serial correlation.

By partially differentiating equation (5), log of per capita GDP growth (Lgdppcgr) with respect to health expenditure (hex) for all developing countries the parameter of (hex) (1.799) in linear form is statistically significant at ρ = 0.01, which indicates that a one percent increase in health expenditure in developing countries is associated with an average per capita GDP growth rise of 1.80 percent, assuming all other factors remain constant. This result buttress the findings in similar studies (Bloom et. al., 2004; Gyimah-brempong, 2004; Seder, 2015; Bhargava et al, 2001). Bhargava et al (2001) study revealed positive effects of adult survival rate (ASR) on GDP growth rates in poor countries. Barro, (2013) attests that an improvement in health is one of the key determinant of economic development. Kuloglu and

Topcu (2016) examine the long run and the causal relationship between health expenditures and economic growth in the Eurasian Economic Union. Their findings show that the impact of health expenditures on economic growth is even larger than that of capital accumulation. Contrary, Odubunmi et al (2012) found a negative impact of public health expenditures on Nigeria's economic growth. A plausible explanation could be that the authors considered only one developing country. Moreover, it can partly be explained by the decrease in foreign aid intended for better health for developing countries, and/or government policies diverting such aid to other sectors of the economy.

The positive coefficient for hex reveals that per capita GDP growth increases as total health expenditures expand. Could this positive effect be attributed to foreign aid for healthcare facilities and government health policies in developing countries? Note that the coefficient of health expenditures (hex^2) in a quadratic way is negative (-0.083) suggesting a diminishing rate that is consistent with the predictions of Schultz (1999). To test whether a marginal change in an increase in health expenditure has a positive impact on economic growth, I multiply the quadratic value (-0.083) by 2, and then by the mean of hex (2.859). I thereby subtract the resulting value of the coefficient of hex, which yields a positive value, (1.324) on average in per capita GDP growth. However, this marginal change is less than the coefficient of hex (1.799). This demonstrates that per capita GDP growth increases as health expenditure expands, but at a decreasing rate. Therefore, this paper can potentially contribute to the understanding of the magnitude of the impact of health expenditure in per capita GDP growth. It also informs governments in developing countries about better health policies as part of the growth engine for per capita GDP in developing countries.

$$\frac{\partial Lgdppcgr}{\partial hex} = 1.799 + 2(-0.083)x2.859$$
$$= 1.324 > 0$$

Poor health does not affect only developing countries economic well-being. It is a global issue. People in developing countries serve as consumers of the world market, whereby their offspring will one day contribute to the stream of innovative ideas and innovations, or remain on the sideline as utilized human potential which has a detrimental effect on economic growth. Moreover, because of the low levels of public health expenditure and low GDP per capita in developing countries, communicable diseases such as tuberculosis (TB), diarrhea and Malaria are some of the top diseases that afflict people in developing countries, especially in Africa. These diseases recognize no borders and remain an ever-emerging threat to those in developed countries, as much as they do in developing countries. This suggests that an improvement in foreign aid for health facilities in developing countries accompanied by macroeconomics, fiscal policies on health may prove universally beneficial.

The findings in this study are consistent with the conclusions in (Serdar, 2015) where the direct impact of total health expenditures on economic growth in Turkey is positive; however, its indirect impact is negative and significant. In other words, total health expenditures as a percent of gross domestic product (GDP) has a positive effect on total output and makes an impact of increased aggregate demand and expenditures. For developing countries, the positive impact of health expenditures on GDP makes it possible for governments to release funds for investment in education. So, better health and quality education increase the level of human capital, thus enhance labor productivity, which in turn increase output. This is proven by the positive and significant coefficient of education and labor as evidenced in Gyimah-brempong and Wilson (2004), Cervellati and Sunde (2002), and Schultz (1999). For example, Schultz asserts that the low levels of health constitute a defining factor of slowing development in Africa because of human capital constraints. Also, Fogel (1994) attributes the gains in labor productivity in the last 200 years in Western Europe to improvements in health and nutrition. Appiah & McMahon (2002) also revealed that non-monetary benefits of investment in education have an indirect impact on better health; hence positive effect on economic growth, which may potentially expand investment in health.

Moreover, healthier workers are less likely to be absent from work due to illness or illness of a family member. They are more productive because they are mentally and physically energetic and robust

(Schultz and Tansel, 1993; Weil, 2005), and therefore has a positive impact on per capita GDP growth. Furthermore, healthy workers have lucrative jobs and can spend more, thus increase a country's total expenditure. This has a multiplier effect on output. However, low levels of investment in health may produce less active and less productive labor force, which is more likely to cause a decline in per capita GDP growth. In addition, it is important to note that in general, economic development in developing countries has not kept pace with soaring population, which is a major concern. Until population in developing countries is stabilized an investment in health expenditure may not make a positive impact on per capita GDP growth.

(b) Is the impact of health expenditure on per capita GDP growth in developing countries different from that of SSA countries?

I rerun equation (5) with the interaction term, health expenditures and Sub-Saharan Africa (hex x ssa) to determine whether the interaction effect of health expenditure and SSA countries on per capita GDP growth is different for health expenditure and per capita GDP in developing countries. The estimated values of the variables are reported in Colum 3 in Table 3. The parameter for hex is positive and significant, while that of the quadratic term hex^2 is negative and significant. To determine whether an increase in health expenditure adds to an improvement in per capita GDP growth in SSA countries, I estimate the following:

$$\frac{\partial Lgdppcgr}{\partial hex} = 1.904 + 2(-.090)x2.859$$
$$= 1.389 > 0$$

My estimates show that the marginal effect of increased health expenditure on economic growth is positive in SSA countries. However, this value is less than the parameter of hex, suggesting that per capita GDP growth improves as health expenditure expands, but at a decreasing rate. My estimates show that the impact of health expenditure on per capita GDP growth is stronger in SSA, because health policy interventions in Sub-Saharan African countries have a precise quantitative payoff on economic growth that is slightly higher than that of the developing countries as a whole. Nevertheless, the full effect on SSA countries per capita GDP growth can only be assessed when the policy changes in health are sustained for a longer period of time to allow systematic changes in labor productivity. Statistics have shown that maternal mortality is also one of the top diseases that afflict mothers in SSA. In SSA, women dominate the informal sectors in agriculture and commerce, thereby contributing to GDP. Therefore, maternal mortality has a negative impact on per capita GDP growth as evidenced in Kirigia et al (2006). Consequently, as policy makers in Africa strive to improve GDP, it will also be more effective if they consider health policies aimed towards the reduction of maternal mortality.

I now estimate the relationship between SSA, the dummy variable (ssa) and per capita GDP growth. As you can see in Table 3, SSA is positive, but not significant when I consider all developing countries. This suggests that health expenditure is not relevant in determining per capita GDP growth. Now, I determine whether the interaction effect of health expenditure and SSA on per capita GDP growth is significantly different from the effect of health expenditure on per capita GDP growth in developing countries. I find that the interaction effect of health expenditure and SSA is positive and significant at 0.05 level. This indicates that the composition of the intensity of health expenditure is relevant in determining the interaction of health expenditure on per capita GDP growth. But for SSA, as health expenditure expands, it is negatively related to per capita GDP growth and it is statistically significant, suggesting that an increase in SSA population average undermines the positive effect of health expenditure on per capita GDP growth.

TABLE 3
THE EFFECT OF HEALTH EXPENDITURE ON PER CAPITA GDP GROWTH

Variables	System GMM Without the interaction Term	System GMM With the interaction term
$Lgdppcgr_{t-1}$	0.172***	0.169***
	(0.000)	(0.000)
hex_{t-1}	1.799***	1.904***
	(0.000)	(0.000)
hex^2_{t-1}	-0.083***	-0.090***
	(0.008)	(0.000)
lft_{t-1}	0.318***	0.287***
	(0.000)	(0.007)
ger1total	0.025***	0.022***
	(0.001)	(0.000)
ssa	0.233	-3.095**
	(0.732)	(0.038)
hex x ssa		0.930**
		(0.019)
Number of observations	1,948	1,948
Number of countries	139	139

*** p<0.01
** p<0.05
* p<0.10

CONCLUSION

The purpose of this paper is to examine the impact of health expenditure on per capita GDP growth in developing countries and to examine if the impact is different from that of SSA African countries. I use a panel data and the system GMM estimator to determine if there are differences in the results of developing countries and that of SSA countries. My findings show that investment in health positively correlates with per capita GDP growth, and they are consistent with the findings in Bloom et al. (2004), Gyimah-brempong and Wilson (2004), and Bhargava et. al (2001) that support the argument that investing in health, has a positive effect on economic growth. I find no significant difference in the impact of health expenditure on per capita GDP growth in developing countries as a whole and SSA countries. Rather, the magnitude of the impact is slightly higher in SSA countries. This suggests that for SSA countries, because of low productivity, any slight improvement in health expenditure policy makes a robust impact on human capital. The workers become more active, energetic and productive, thus cause a precise quantitative payoff on per capita GDP growth. Therefore, it is crucial for policy makers in SSA countries to consider investment in health as one of their top priorities if they want to make a sustainable growth in per capita GDP. The policy implications are that if developing countries desire high levels of per capita GDP growth, they can do so by investing in health, which has the potential to increase their human capital. Unlike other similar studies where the authors had considered only one country, the advantage of my study is that it is broader expansive looking at developing countries as a whole. Therefore, my study contributes to the literature because any country in the developing world can apply the findings in their policies on health expenditure.

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