MALARIA AND ECONOMIC GROWTH IN NIGERIA: AN ECONOMETRIC ASSESSMENT.

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Abstract
This study examined the impact of Malaria on Nigerian economic growth performance for the period (1992-2013). Annual time series data on real GDP, malaria incidence, Gross fixed capital formation, Public Health Expenditure and secondary school Enrolment rate were obtained from both Central Bank of Nigerian statistical Bulletin and World Bank Development Indicators. The stationarity state of the variables was examined using Augmented Dickey Fuller Test. The variables are integrated of order one. The trace statistics reveal that the variables are co-integrated, hence a long run relationship exist among the regressand and regressors. The parsimonious ECM reveals that malaria significantly impact on economic growth. Among other things the study recommends that intensive efforts should be made to redress the menace of Malaria.
Key words: Malaria, Economic growth, ECM and Nigeria.

1.0 Background of the Study

Malaria remains a major threat to public health despite decades of control efforts. It is a devastating disease that threatens the economic growth of endemic countries. According to World Health Organization (2010), there are still over 200 million cases of malaria and approximately one million deaths annually. Malaria constitutes 10% of Africa's overall disease burden, accounting for 40% of public health expenditure, 30-50% of in – patient hospital admissions and up to 50% of out-patient visit in areas with high transmission (WHO, 2006). Malaria morbidity and mortality rate vary from region to region in SSA. In Nigeria, Malaria is the number one public health problem (Onwujekwe, 2000) and it is responsible for about 300,000 death every year (Coker H.A.B, C. M Chukwani, H.D. Ifudu and B.A. Aina, 2001in Egbuche, 2013). Approximately 50% of the Nigerian populations experience at least one episode per years. However, official estimate suggests as much as four (4) bouts per persons per year on the average (WHO, 2002).

A healthy workforce is one of our most important economic assets as a nation. Health is the most valuable asset to human being. According to Grossman (1972), asserts that quality health will free up qualitative hours for the individual to engage in production. Healthy individuals are in a better position to coordinate their knowledge in the production process. Malaria erodes human strength. It physically and emotionally weakens the victim and, causes obstacles in the productive lives of the people. Good health and productive work force are important in the economy of any nation especially in the fight against poverty. Good health

enhances work effectiveness and the productivity of an individual through increased physical and mental capabilities (Ajani & Ugwu, 2008).

The menace of diseases, like malaria, poses great challenge to both human capital and economic development in Nigeria. A lot of effort has been committed to malaria control, nationally and internationally. This is due to the need to meet development targets such as those set in the Millennium Development Goals (MDGs), adopted by the United Nations and also meeting the government health policy of enhancing a healthy populace. The importance of this issue is spelt out in the sixth MDG which is to reduce to half, Malaria prevalence between 1990 and 2015 (Alaba & Alaba, 2011).

These high incidence or effect of malaria on health outcomes in Nigeria could be attributed to poor accessibility to health service as well as ignorance of the causes and mode of transmission of it in Nigeria. However, the commitments of government at all tiers, including individuals and institutions to the eradication of malaria have been increased overtime in recent times. This started with the integration of malaria eradication into national and international development strategies and actions are expected to produce improved developments results.

Given that malaria is endemic throughout Nigeria and that more than half of the country's population is living below poverty line, malaria incidence may increase significantly in Nigeria because many may not be able to afford the newly introduced expensive drugs due to poverty. This has serious implications for the achievements of development blue print in the National Economic Empowerment and Development Strategies (NEEDs), the MDGs target and Nigerian vision 20:2020. Effective control of malaria is capable of reducing household poverty, improvement in health outcomes, human capital development, welfare and aggregate national development in Nigeria. This is because of the positive dividends of good health on productivity and economic development generally.

2.1 **Conceptual Clarification**

Malaria is a term commonly used for four species of malaria plasmodia that infect human beings. They are plasmodium falciparum, plasmodium vivax, plasmodium ovale and plasmodium malaria. Plasmodium falciparum is the most dangerous form of the disease, accounting for 90 percent of malaria deaths in the world (WHO, 2008). Plasmodium vivax is less virulent but significantly harder to eliminate by interrupting transmission between humans and mosquitoes because it can maintain itself in a dormant phase in the human liver for six months. Plasmodium ovale and malaria are the least virulent species of malaria, but may also persist in the body for months or years (Benjamin, Mangbeni Tsegai & Ringler, 2012).

Malaria is a disease that is common to both young and old in Africa countries like Nigeria. For instance, in Nigeria, malaria accounts for 60% of out-visits and 30% of hospitalizations among children under five years of age. With a population of over 70 million people, at least 50% of the populations in Nigeria suffer from at least one episode of malaria each year an more reported cases or deaths due to malaria than any other country in the world (WHO, 2012).

The World Health Organization defines health as a state of complete physical, metal and social well being and not merely the absence of disease or infirmity (Parrish, 2010). Health outcomes have been described as measures of the end result of what happens to patients or individuals as a consequence of their encounters with a particular disease or the health care system.

Weisbrod et al (1973) also noted that malaria diminishes a worker's productive capacity for a given number of hours worked. He measured worker's actual productive capacity by their earnings which comprise the type of job done and the number of days worked per week. Using data from rural labour participations, Ryan Wallance (1986) in Ryan Wallance, (2014) found that health has a significant positive effect on males but not on female wage rates. Records, also show that of all tropical disease malaria singly slowed down economic growth in Africa by 1.3% each year (WHO, 2005). These estimates includes loss of work efficiency and time, which leads to loss in income earning capacity, family welfare, premature deaths of children and the non improvement of living standards for future generation (Marrow, Smith & Nimo, 1982).

Malaria affects the economic status of households through days lay off from productive activities. Previous studies on the effect of malaria on economic growth and labour productivity, yield varying results. These difference in results could, however, be explained by variations in study methods and content. However, it is generally accepted that malaria affects the quality of output. No matter the argument, it should be noted that, even though an acute malaria attack might not prevent people from working, it is however capable of slowing down productivity rate and hence efficiency rate. It can reduce the quality of productivity and output (Goodman, 2000). For example, some researchers have argued that malaria reduced the agricultural production by reducing the working capacity of farmers (Kwadwo, Asanta, Tarekegn and Andam 2011). Hong (2005) argues that increased exposure to malaria infections significantly reduces labour productivity of migrants by 8.9% compared to when they are healthy. Hence the labour productivity of infected persons when compared with potential capacity would always suffer a reduction and inefficiency. Therefore, the economic loss from productivity would be substantial most especially for labour intensive occupations that requires physical strength. He further concludes that malaria's economic burdens extend far beyond direct measures of income loss, considering the reduction in labour productivity over time to include reduction in standard of living of dependants and relations. Malaria therefore, has an effect on labour supply and productivity of worker. Working through the measurement of worker productivity is often difficult to capture because workers' performance is not directly tied to an observable output as in price rate work.

2.2 **Economic Burden of Malaria**

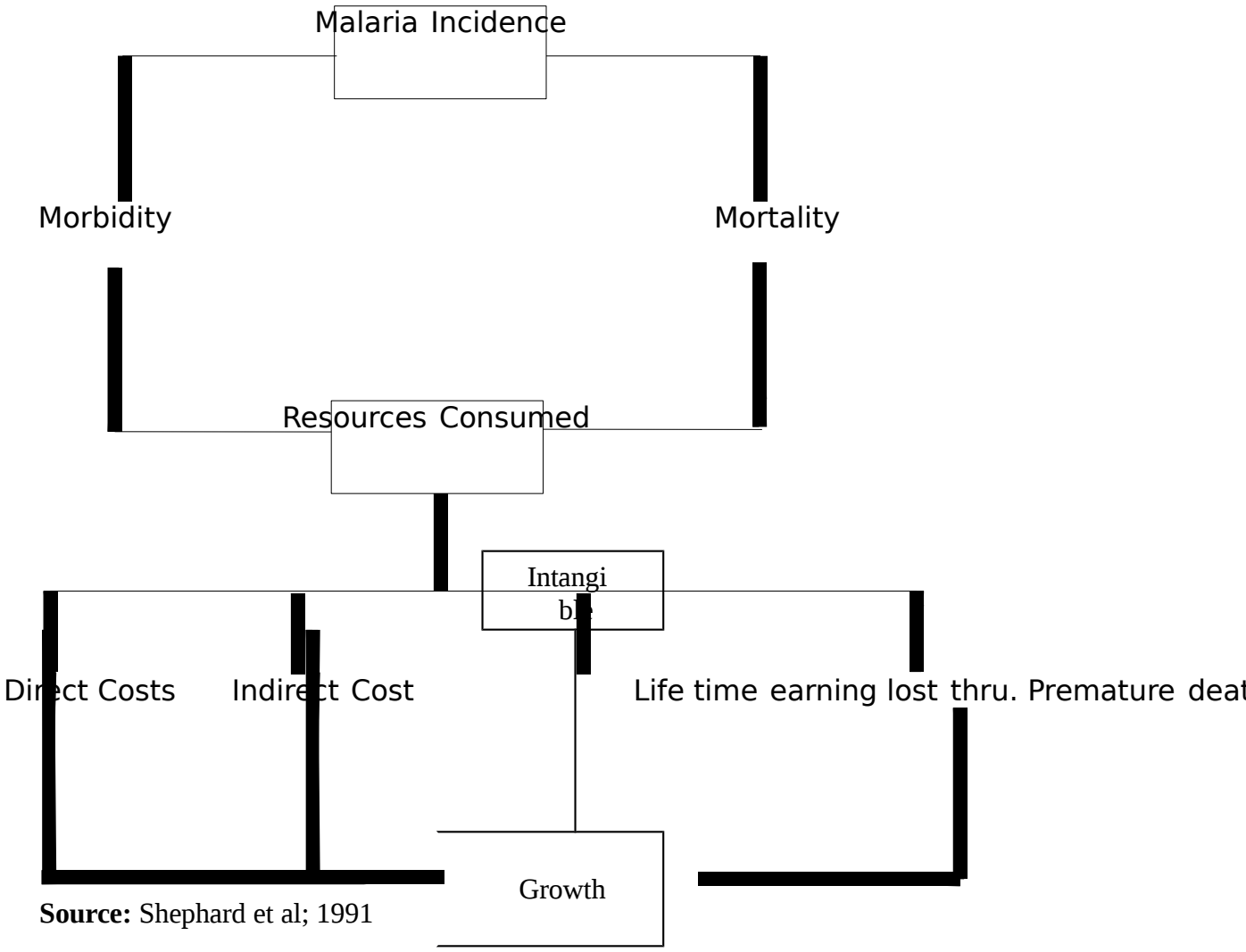
The devastating effects of malaria and poverty on labour productivity was recognized early enough in literature (Sinton, 1935 in Stanley, 1991,Target, 1991 and Madhukar, 1997). Malaria has remained a major health challenge in the tropics of Sub-Saharan Africa and Nigeria in particular. The disease is resistant to drugs' and insecticides control. Malaria affects both the quantity and quality of production resources especially human factors in the production process. In recent studies of malaria endemic countries, the standard method for measuring the economic burden of malaria has been to measure the number of work day's loss due to malaria infection multiplied by daily wage rate (Chima, Goodman, & Mills, 2003 in Obinna, 2013).

At the macro level, malaria limits mobility of labour and reduces the quality of skills exhibited at work. Gallup & Sachs (1998) in Gallup & Sachs (2001) and Acemoglu and Johnson, (2007) began their investigation of macro economic impact of malaria by suggesting a coincidence between severe malaria and low incomes. The study worked on the assumptions that low income could be due to many other factors apart from malaria. They further concluded that malaria could simply be a proxy for the growth constraints Africa is facing. This may also be explained by other reasons such as weak institutions, poor economic policies and or ethnic

conflicts. Based on their empirical findings however, it confirms that malaria has a strong negative association with income after controlling for other factors. Malaria's coefficient increased between 1950 to 1995, suggesting that malaria is an important variables in explaining income levels of many countries in Africa.

At the micro level, imagine the household where fundamental decisions are made. Here malaria strips families of their main sources of finance. For the affected individuals, the consequences may include stress and sometimes even death. Hence, a critical need to cater for those affected and to fund ways of replacing their contributions to the family and community. A decrease of labour productivity, coming from loss in income, reduces support for the elderly and the growing burden of orphans is therefore left on families and some friends. This in turn, through a multiplier effect, spreads down to the economy. Thus this translates to substantial direct and indirect cost, loss in life time earnings and investment through premature deaths resulting from malaria. All of these determine poverty and welfare status of the households (Shepherd, 1991in Mia, 2016). Summarily, the cost of malaria can however be considered from different perspectives which includes; death rates from Malaria attacks, prevention and treatment cost and indirect cost (productivity and income loss). Below is Shephard malaria economic burden model presented in figure 1.

Fig 1: Economic Consequences of Malaria



Source: Shephard et al; 1991

The dual health effects of morbidity and mortality may lead to the consumption of already scarce resources through its treatment and prevention. This therefore leads to drain on the finance of the people given that in this part of the globe most health care expenditures are borne by individuals or on the household. To this regard, it serves as major cause of school absenteeism and negatively long term learning capacities of individuals thereby reducing human capital accumulation over time. This effect is further compounded by more complicated links between malaria and productivity

2.3 **The Solow-Swan Growth Model**

The neoclassical growth theory seeks to understand the determinant of long term economic growth rate through accumulations of factors inputs such as physical capital and labour. In the heart of the neoclassical model lies the Solow-Swan growth theory. It is an aggregate production function that exhibits constant returns to scale in labour and reproducible capital. This can be written in general form as follow:

$$Y=F(AK,L) \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad (1)$$

Where Y= output or income

A=Technological Innovation

L=Labour force

K= stock of capital

Such that labour productivity is given by $Y=\frac{Y}{L}$ and capital intensity is given by $K=\frac{K}{L}$

Alternative, the per capita worker production function can be written as

$$Y=F(CK)=K^{\alpha} \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad (2)$$

The neoclassical model can therefore be modified by supposing that there is a productivity/technological parameters A in the aggregate function that reflects the current state technological knowledge

$$Y= F(A_iKL) \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad (3)$$

Assuming that productivity increases smoothly overtime at a constant growth rate (g), hence

$$Y= A_o g^{st} K^{\alpha} L^{i-\alpha} \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad (4)$$

Equation (4) shows that growth in income is determine by productivity growth (g) and the growth of capital per worker

2.4 **The Romer Model**

In his article published in 1990, Romer took a different approach in accounting for technological progress. This model assumed that technological knowledge is labour augmented, enhancing their productivity. The production function is expressed as

$$Y= K^{\alpha} (AL)^{1-\alpha} \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad - \quad (5)$$

So that (AL) denotes a knowledge adjusted workforce. Furthermore, the model assumed that research create technological knowledge in a simple form, expressed thus:

$$\frac{dA}{} = SH_A$$

dT

Where H_A is the human capital and S is a parameter. Romer posited that the rate of technical progress will be determined by the stock of human capital of research workers. In other words, an economy with a larger total stock of human capital will grow faster (Romer, 1990). Thus Romer model explicitly recognizes the role of human capital in economy growth. Equation 5 above can be expressed in linear form as:

$\log Y = \alpha \log k + (1-\alpha)\log A + (1-\alpha)\log L + \varepsilon$----------6

3.0 Theoretical Framework

This study adopts the neoclassical production function which expresses output (Y) as a function of capital (K), Labour (L) and the coefficient of technical progress (A). The production function is as expressed below.

$Y = AF(K,L)$ - - - - - - - - (7)

Where A is the level of technology, K is the physical stock of capital, it is the human capital, L is the quantity of labour and Y is output. It is usually assumed that the production function is twice differentiable and subjected to constant return to scale.

In the exogenous growth models, technical change is assumed to be exogenously determined while endogenous growths models assume that technological progress is endogenous determine. In what follows, we adopt the framework of endogenous growth models. In the endogenous growth theories, income growth is determined by technological progress (A), which is a function of profitable research and development activities. In other words, technological innovation and absorption, as reflected in total factor productivity (TFP) are essential for growth and wealth. According to Hall and Jones (1998), more than 80% of income differential among countries are attributed to TFP differences. The question is what explains total factor productivity differences? To this, Hall and Jones (1996) asserted that it is social infrastructure. Social infrastructure comprises of institutions and government policies. Therefore, in what follows it is assumed that productivity depends, inter alia, on malaria incidence (MI), Life Expectancy Rate (LER) and public Health Expenditure (PHE).

RGDP = F (GFCF, SSER, MI, LER, PHE) - - - - (8)

Following equation 6 above equation 8 is expressed in its log-linear form to get:

$LRGDP = \grave{u}_0 + \grave{u}_1 LGFCF + \grave{u}_2 LSSER + \grave{u}_3 LMI + \grave{u}_4 LLER + \grave{u}_5 LPHE + \varepsilon$ - (9)

A-priori expectation: B_1, B_2, B_4 and $B_5 > 0$, $B_3, < 0$

RGDP is Real Gross Domestic Product, GFCF is Gross Fixed Capital Formation, SSER is Secondary School Enrolment rate, MI is Malaria incidence LER is Life Expectancy rate at birth, PHE is public health expenditure B_0, is Intercept while B_1, B_2, B_3, B_4 and B_5 are the impact measuring parameters for the various explanatory variables and L is natural logarithmic value of the respective variables.

3.1 Methodology and Sources of Data

In order to lend empiricism to our work, we shall employ the use of regression analysis. Total Productivity proxied, by Real Gross Domestic Product, is regressed on gross fixed capital formation, secondary school enrolment rate, malaria incidence, life expectancy rate at birth and public health expenditure.

Times series data obtained from National bureau for statistics and the central bank statistical bulletin are utilized. The scope of the work is (1991-2013). This period is chosen for the fact that it marks the period of intense implementation of the "Roll Back Malaria Programme" in Nigeria. There is high tendency that economic time series variables are non- statunary at levels, but may become statunary only after first differencing or second (Iyoha, 2011; Guyarati, 2009). The dangers inherent in using non-stationary time series variables in running regression has been established (see Granger & Newbold, 1974; Box and Jenkins, 1970 in Box and Pierce, 2012; and Yule, 1926). The study employed Augumented Dickey-Fuller tests statistics to ascertain the stationarity status of the time series. The Engel-Gragier two stage and that of Philip Ouliaris cointegration tests are employed in determining the existence of long run relationship between the regressand and regrssors. This was adopted because the specified empirical model is linear. The confirmation of this, culminated in the specification and estimation of the error correction mechanism (ecm) model.

4.1 **Empirical Analysis**

In this section of the study, results of the relevant statistical tests as well as those of the econometric estimation are presented thereafter recommendations are proffered. The results are presented in the order of unit root; co-integration analysis and the parsimonious Error Correction Model.

4.2 **Stationarity Test**

In this section of the study, we examine the Stationarity Sate of the variables. The aim of the exercise is to know the order of homogeneity of the variables that is whether they are integrated of order Zero or One. The study utilized the Augmented Dickey Fuller approach which is presented in table 4.1 below:

Table 4.1 Summary of Unit Root Estimates at 5% Level of Significance

Augumented DickeyFuller Test Statistics@ Levels				Augumented DickeyFuller TestStatistics@ 1st Difference				
Variables	Lag	Test Statis	Critical Value@5	Variables	La	Test Statis	Critical Value@5	Remark
LRGDP	0	-1.843652	-3.587527	D(LRGDP)	0	-37.792	-3.592973	Stationary
LSSER	0	-1.200961	-3.548490	D(LSSER)	0	-7.9972	3.557759	Stationary
LMI	0	-2.114342	-3.587527	LDMI	0	-6.0392	3.562882	Stationary
LPHE	1	-2.14072	-3.548490	D(LPHE)	1	-4.47695	-3.562882	Stationary
LGFCF	1	-1.65341	-3.546728	D(LGFCF)	1	-5.34721	-3.57342	Stationary

Source: **Author's Computation Using E-view 8.0**

4.3 **Co-integration Analysis**

In the Literature, two or more variables are said to be co-integrated if a long-run meaningful relationship exist among them. When two or more variables are co-integrated, then a linear combination of the programmes will produce stationary series regardless of the stationarity state of the variables at levels. In this study, we utilized the Johansen's approach in testing for Co-integration. The results are presented in table 4:2 below.

	Engel-Granger Cointegration Test		Philip Ouliaris Cointegration Test	
Dependent	Tau-statitistic	Probability	Tau-statistic	Probability
LMI	-2.632162	0.6270	-5.659965*	0.0036
LPHE	-5.304839*	0.0081	-5.440720*	0.0060
LSSER	-3.151255	0.3809	-3.534724	0.2316
LRGDP	-9.955475*	0.0000	-8.821351*	0.0000
LGFCF	-7.368932*	0.0000	-6.984531*	0.0007

Source: **Author's compilation using E-view 8.1 * Significant @ 5% Level of Significance.**

Table 4.2 above shows the Engel Granger two stage and Philip Ouliaris cointegration tests results. From it, result shows three and four cointegrating vectors respectively in both Engel-Granger and Philip Ouliaris results. This thus results into the rejection of the null hypothesis that there is no cointegration between the dependent and the independent variables in the empirical model. This implies that a long run relationship do exist between the regressand and regressors.

4.4 **The Parsimonious ECM**

Under the parsimonious ECM, we simply regress RGDP on the independent variables (LGFCF, LMI, LPHE, LSSER). The ECM is introduced so as to ascertain the speed of correction of the dispersion between the to the short and long run dynamics. The estimated model is presented in table 4.4 below.

Table 4.4: The Parsimonious Error Cerrection Mechanism Results

Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob**
Constant	0.1786	64095.66	0.0027	0.5832
LGFCF	-0.0098	0.0047	-2.0853	0.0428
LMI	-0.3774	0.0097	-3.9908	0.0006
LPHE	0.0451	0.1171	1.9618	0.0346
LSSER	0.6399	0.0027	2.8876	0.0067
ECM(-1)	-0.6263	0.2965	-2.1123	0.0082
R-squared=0.98	**Adjusted R** squared= -	**F-statistics** = 108.95	**Prob.(f-stat.)=** 0.00	**DW Statistic** =

Source: Authors Computation (2016)

4.5 **ECM Results**

Table 4.4 above shows the results of the parsimonious error correction model. From it all the variables but one (LGFCF) were correctly signed. LGFCF is a variable proxying infrastructure. For it to be negatively signed violates the a-priori expectation because it is expected theoretically, that as infrastructure grows RGDP would also grow since infrastructure facilitate production. The case of Nigeria here may be predicated upon inefficiency and corruption. All the

variables but public expenditure on health (PHE) were statistically significant at 5% level. This also shows the gross inadequacy of government expenditure on health.

From the results also, the constant is 0.1786 implying that, even if all other variables were equated to zero there will still RGDP growth of 17.86% in Nigeria. For the other variables, it shows that there will be a 0.0098% decrease in RGDP growth owing to 1% increase in GFCF.Similarly RGDP will reduce by 37.744% due to 1% increase in malaria incidence (MI). On the other hand, 1% increase in public health expenditure (PHE) and secondary school enrolment rate (SSER) will yield 0.0451% and 0.6399% in RGDP respectively.

The coefficient of determination (R^2) is valued at 0.985 showing that 98.5% of the variation in RGDP is due to the variation in the included regressors, while the remaining 1.5% is due to the stochastic error ten adjusted When adjusted to its degree of freedom, the coefficient of determination becomes 93.89%.Thus the regressors essentially account for 97.6% systematic variation in RGDP in Nigeria. The F-statistics = 108.95 with p-value = 0.000 shows that, at 1% level, there is a statistically significant relationship between the RGDP and the regressors in the model. The Durbin-Watson statistic of 1.96 shows absence of autocorrelation in the empirical model. This implies that all the forecast estimates of the error correction mechanism are *efficient*. The ECM is statistically significant at 5% level and correctly signed. This implies that up to 62.63% of deviation between the short and longrun equilibria is corrected annually by the ecm. Results converged after 10 iterations.

5.1 **Policy Implication**

- The above results present some issues of policy interest.
- Infrastructure (GFCF) is shown to be negatively related to RGDP against all expectation. This confirms the existence of this age long challenge to productivity in Nigeria.
- Public expenditure on health (PHE) not being statistically significant also confirms the unserious policy attention paid to the health sector by the government.
- Malaria incidence (MI) and secondary school enrolment (SSER) being statistically significant and correctly signed shows that they are critical drivers of economic growth in Nigeria and thus requires serious policy attention.

5.2 **Policy Recommendation**

- Base on the foregoing, this study recommends as follows:
- Infrastructure should be adequately provided and monitored
- Budgetary provision for the health sector should be appreciably increased and faithfully executed.
- More serious policy attention should be given to malaria eradication.
- Education is critical to the cultivation of healthy habits. Thus more serious policy attention should be given to the development of functional education in Nigeria.

5.3 **Summary and Discussion**

This study examined the impact of malaria incidence on Nigeria's economic growth. Annual time series data for the period (1981-2013) was utilized. Our secondary data was obtained from the central Bank of Nigeria statistical Bulletin, Nigeria Statistical Bulletin and world Development Indicators. The study proxies economic growth by real Gross Domestic Product. The stationarity state of the variables was examined using augmented Dickey Fuller (ADF) and the series are homogenous of order One. The Engel- Grangier two stage statistic shows that residual is integrated of order zero at 5% level, thus confirming cointegration. The parsimonious ECM reveals that malaria incidence crowd out economic growth performance. The study therefore validates several studies that show that the growth rate of per capita income for a Malarions society is half that of a non Malarions society. Again, Public Health Expenditure does not significantly impact on Nigeria's economic growth. Secondary school Enrolment rate positively and significantly impact on economic growth. Against the back drop, it becomes pertinent to give intensive policy efforts towards tackling the Menace of malaria in Nigeria. This is very important for the attainment of the macroeconomic goal of rapid economic growth and development.

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