IMPACT OF MALARIA PREVALENCE ON LABOUR PRODUCTIVITY IN NIGERIA

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Abstract

This study investigated the impact of malaria prevalence on labour productivity in Nigeria from 1999-2021. Malaria is both a significant public health and economic concern with high prevalence rates in Nigeria. In 2021, Nigeria had the highest threat of malaria globally and this affected productivity and death rates. The Generalized Method of Moments (GMM) estimation technique was employed and the results indicated that: there is significant negative relationship between Labour productivity and malaria prevalence in Nigeria and an increase in government recurrent expenditure on health resulted in an increase in labour productivity. The study concluded that if we desire a high level of labour productivity growth, we can achieve it by increasing and improving the stock of health human capital. Therefore, malaria treatment and preventive policy measures by way of government interventions programs for controlling the malaria disease are urgently needed to reduce the malaria transmission in Nigeria.

Keywords: Malaria, labour, productivity,
JEL Codes: H46, K20

1. INTRODUCTION

African region has about 95% of all malaria cases and the threat of malaria is highest in sub-Saharan Africa, and 4 countries in that region accounted for nearly half of all malaria deaths worldwide in 2021: Nigeria (26.6%), the Democratic Republic of the Congo (12.3%), Uganda (5.1%), and Mozambique (4.1%). (WHO, 2023). With a population of 200 million people, Nigeria has more reported cases of malaria and deaths due to malaria than any other country in the world (WHO,2010, 2023). The 2008 Demographic and Health Survey (DHS) reported an infant mortality of 75 per 1000 live births and an under-five mortality of 157 per 1000 live births in the preceding

5-year period. The magnitude of incidence and death due to malaria is a multiple of all other tropical diseases put together and it is responsible for over 90% of reported cases of tropical disease in Nigeria (Alaba & Alaba, 2003). Individuals suffering from malaria illness may be weak, unable to work or study and generally unable to provide for self-dependents. At a more aggregated level, however, it seems likely that a high disease burden may have an adverse impact on a country's productivity, growth and, ultimately, economic development (Abdulsalam, 2008).

Economic theory suggests that malaria reduces productivity of labour and increases the already high mortality rate of the Nigerian population. Labour generally regarded as the most dynamic of all the factors is a key input determining the quantity of output that can be produced with a given technology. Other things being equal, the greater the quantity and quality of labour, the larger the volume of output produced (DeLeire and Manning, 2004 cited in Alaba and Alaba, 2003). One of the channels through which disease affects economic outcomes is through the productivity of workers. People who are sick cannot work as effectively as those who are healthy. They are physically weaker and mentally less acute. Sometimes they cannot work at all. The lower labor input due to disease reduces total output. Labour productivity in Nigeria has not only been low but declining (see Adenikinju, 2005; Ingwe *et al.*, 2010; Awe and Ayeni, 2010). Unfortunately, empirical studies on the impact of malaria on labour productivity are scanty particularly in Nigeria. With Nigeria being malaria endemic and labour-intensive economy, importance must be accorded to having a healthier workforce in order maximize productivity (Awogbemi, 2003).

It is important to look at the economic impact of endemic diseases like malaria which grossly affect the morbidity and mortality rates, as well as economic development of Nigeria. The financial loss due to malaria annually is estimated to be about N32billion in the form of treatment costs, prevention, loss of man-hours (productivity), etc (FMOH 2023). In addition, the economic burden of malaria on households and individuals is substantial due to human morbidity and mortality; hence this reduces labour productivity and output per worker. Malaria therefore is not only a public health problem but also a developmental problem.

Therefore, this study examines the impact of malaria prevalence on labour productivity in Nigeria. To achieve this the study is organized into five sections. Section 1 is introduction. Section 2 is literature review. Section 3 is methodology. Section 4 is empirical analysis. Section 5 is conclusion and recommendations.

2. LITERATURE REVIEW

2.1.1 Health and Malaria

The world health organization (2010), defined Health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. This implies that health is the general condition of the body or mind, especially in terms of the presence or absence of illnesses, injuries, or impairments. Good health is a crucial component of well-being. Bloom & Canning (2008) observed that it seems to be a logical assumption that good health raises human capital levels and therefore the economic productivity of individuals and a country`s economic growth rate. Better health increases workforce productivity by reducing incapacity and the number of days lost to sick leave, and reduces the opportunities an individual has of obtaining better paid work. Furthermore, good health helps to forge improved levels of education by increasing levels of schooling and scholastic performance.

Poor health condition exposes individuals to diseases or ill-health. Cole and Neumayer (2005), noted that infectious diseases have two effects; mortality death due to the disease, and morbidity or illness due to the disease. This suggests that a disease has the effect of impairing an individual's ability to participate actively in economic activities. Infectious diseases such as malaria, for instance, result in recurrent debilitating bouts of illness, which prevents individuals from supplying their labour productively. However, in the majority of cases, particularly in labour-supplying adults, malaria is non-fatal, but results in frequent recurrent attacks that affect the productivity of labour supply i.e. affected individuals remain in the labour force, but their productivity is severely impaired (Cole and Neumayer, 2005).

Malaria is a mosquito-borne disease caused by a parasite and is the world's most wide-spread and life-threatening disease. The word malaria comes from the Latin 'malaria' (bad air) (Alnwick, 2002, cited in Idowu*et al.*, 2009). Malaria is one of the most prevalent and challenging infectious diseases affecting developing countries. It is endemic in 91 countries, accounting for 40 per cent of the world's population, and is responsible for over 1 million deaths per year (McCarthy,*et al*., 2000). Clearly such deaths will affect the supply of labour. The labor productivity of infected persons upon return to work would not resume at prior levels. The economic loss from lowered productivity would be substantial, especially for labor- intensive occupations that require physical strength and for individuals who suffer from frequent episodes of malaria (Hong, 2005). Also, human capital accumulation may also be adversely affected by malaria due to the higher levels of school absenteeism amongst those suffering from illness.

2.1.2 Labor productivity

Productivity measures the relationship between the quantity and quality of goods and services produced and the quantity of resources needed to produce them (i.e. factor inputs such as labour, capital and technology). It is important to note here that productivity as a concept doesn't have a general definition because it's both a technical and managerial concept. Roberts and Tybout (1997) defined productivity as a quantitative relationship between outputs and inputs. The implication of this definition is that the term "productivity" describes the relationship between the quantity and quality of goods and services produced relative to the quantity of resources used to produce them. Okojie (1995) observed that the productivity is the ratio of some measure of output to some index of inputs used. In other words, productivity is the numerical value obtained from dividing the amount of output produced by the amount of resources use in producing them.

The 'term labor productivity' connotes ratio of physical amount of output achieved in a given period to the corresponding amount of labor expended. By implication, productivity here means the physical volume of output attained per worker or per man-hour. The productivity of labor can be measured either as output per operator or output per man-hour, expressed in money value (economic productivity) or in quantities (physical productivity). Labor productivity index shows the rate of change in output per person engaged (Olaoye,1985).

This study employs the International Labor Organization (2010) definition which implies that labor productivity is the ratio of GDP to the total number of persons employed in a country. The implication of this encompassing definition is that the productivity of a country's workforce is measured in terms of Gross Domestic Product (GDP) divided by total employment in the economy.

2.3 Theoretical Literature Review

The role of productivity in accelerating the pace of economic growth is well recognized in the theoretical literature on growth. In the neo-classical growth accounting framework, the growth of output is the sum total of the growth of capital accumulation, growth of labor and the growth of productivity or efficiency. The growth theory has evolved over the years as a major feature of development economics. Harrod and Domar (1936) developed a path-breaking theory of economic growth. Since the mid-1950s, a number of economic growth models have proliferated the literature. The endogenous growth models recorded greater landmark contribution in the theories of economic growth. The endogenous growth models make technological process endogenous looking for possible driving force.

Mankiw, Romer and Weil (1992) model is based on the assumptions that constant returns to combined investment in physical and human capital Labour supply is fixed, decreasing returns to

the total capital. The aggregate output of the economy can be written as:

$$Y_T = A_T K_T^{\propto} H_T^{\propto} L_T^{1-\propto\beta} \quad 1$$

Where *A* - index of technical change that varies overtime but for the moment held constant, *K* - the capital stock, *L* - labour supply and *H* is stock of human capital.The coefficients α and β are assumed to lie between 0 and 1 and (α+β) < 1, implying that there are decreasing returns to all capital.

Assuming $s_k$to be the fraction of income invested in physical capital and $s_h$the fraction invested in human capital, the evolution of the economy is determined by:

$$k_t = S_k y_t - (n + g + \delta)k_t \quad 2$$

$$h_t = S_h y_t - (n + g + \delta)h_t. \quad 3$$

Where $y = Y/AL$, $k = K/AL$, and $h = H/AL$ are quantities per effective unit of labour. It is assumed that the same production function applies to human capital, physical capital, and consumption. In other words, one unit of consumption can be transformed at no cost into either one unit of physical capital or one unit of human capital. In a case where $\alpha + \beta$ equals one, then there are no constant returns to scale in the reproducible factors and there will be no steady state for the model. The economy converges to a steady state defined by:

$$k^* = \left(\frac{S_k^{1-\beta} S_k^{\beta}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}}, \quad 4$$

$$h^* = \left(\frac{S_k^{\alpha} S_k^{1-\alpha}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}}, \quad 5$$

Substituting (4) and (5) into the production function and taking the natural logs gives an equation similar to (1).

$$\ln\left[\frac{Y^t}{L^t}\right] = \ln A_0 + gt - \frac{\propto+\beta}{(1-\propto-\beta)}\ln(n + g + \delta) - \frac{\propto}{(1-\propto-\beta)}\ln S_k + \frac{\beta}{(1-\propto-\beta)}\ln S_h \quad 6$$

This equation shows how per capita income (proxy for economic development – a superset of economic growth) depends on population growth and accumulation of physical and human capital. In summary, having reviewed the above growth theories, the Cobb-Douglas production function is the starting point for both the exogenous and endogenous growth models. The most important difference between the exogenous and endogenous growth models is that in the former, the steady-state of growth rate is determined from outside the model (such as technical change or productivity change) while in the latter, it is determined from within the models. Hence, Endogenous growth models accords importance to the production of new technology and human capital development. The model suggests that endogenous factors such as government policies, political stability, market distortions, human capital etc., can significantly affect economic growth.

2.3 Empirical literature

Studies suggest that economic burdens of malaria are highly regressive, that is, the poor households spend a significantly higher proportion of their income on malaria treatment than the high- income families do (Ettling*et al.,* 1994; Attanayake*et al.*, 2000; Chuma*et al.,* 2006). In a study of five malaria holo-endemic Nigerian communities in Southeast Nigeria, Onwujekwe *et al.*,(2009) findings showed that the cost of treating malaria illness accounted for 49.87% of curative health

care costs incurred by the households. Average malaria expenditure was $1.84 per household per month, while it was $2.60 per month for the combination of other illness episodes. The average person-days lost due to malaria and the combination of other illnesses were almost equal. If the financial costs of treating malaria and other illnesses are combined, this cost will deplete 7.03% of the monthly average household income, with treatment of malaria illness alone depleting 2.91%.

A number of studies have tried to establish a correlation between malaria with poverty (Sachs, 2001; Sachs and Malaney, 2002; Chuma*et al*., 2006). They found that while it is true that poverty can contribute to high transmissions of malaria in the poor countries, malaria is not a direct consequence of poverty. Although malaria is widely prevalent in the poor countries of Africa and Asia, its incidence and severity vary largely from one geographical region to another and is also determined by climate and ecological factors. However, it is said that the relationship between economic growth and malaria is two-way (Lieshout *etal*., 2004) malaria worsens poverty and contributes to lower economic growth. Sachs and Malaney (2002) argued that causality may run in both directions. In other words, poverty may promote malaria transmission or malaria may cause poverty by impeding economic growth.

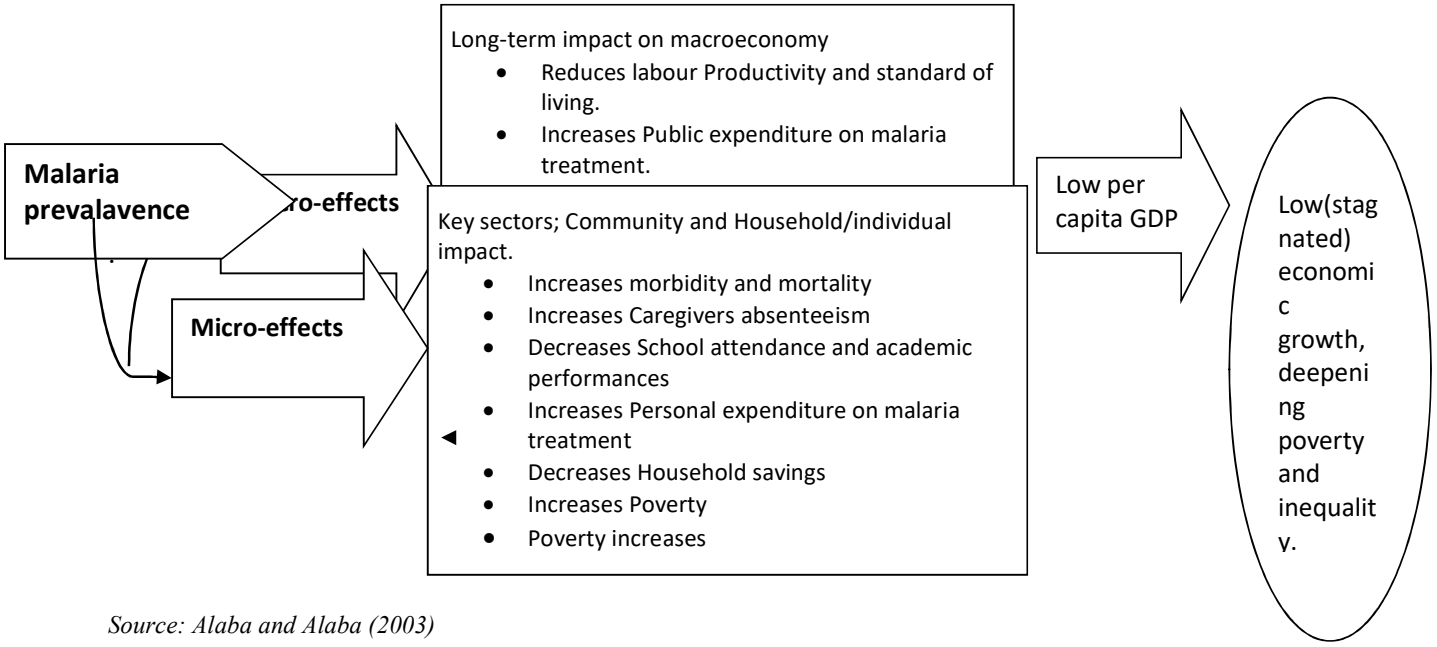
Cole & Neumayer (2005) argued that a key mechanism through which diseases such as malaria affects economic growth is via total factor productivity (TFP). Human capital constitutes a key factor in economic growth. Malaney *et al.*, (2004) argues that human capital accumulation is affected by even more directly by malaria through its effects on school attendance and performance. School-age Children in malaria endemic countries such as Nigeria, fall ill from the disease frequently, which causes school absenteeism. Also, labor productivity could also be reduced by the need to care for sick relatives or by reducing years of schooling if parents are chronically ill. For example, in Kenya, primary school children missed an estimated 20 school days, on the average, per year due to malaria which amounts to over 10% of the total school days (Leighton and Foster, 1993). The study also found that secondary school students missed 8 days, on the average, per year.

2,4 Transmission Channels of the Impact of Malaria on Economic Growth; The Micro-Macro Linkage

Malaria has implications for the development of household members and the country through various mechanisms. Malaria at the household level affects productivity of the people and their assets acquisition capacity. Households face a substantial amount of direct cash expenses to purchase preventive measures and seek treatment for malaria. In addition to direct expenditures on prevention and treatment of malaria, households experience indirect costs of productive time lost due to malaria illness. Kumar,*et al.,*(2007) argues that most of the malaria burden borne by

economically active workforce as the adults loss income, other earnings or valuable time due to becoming ill themselves or caring for and accompanying sick person for treatment.

Figure 1: Economic Effects of Malaria on Economic Growth.



Source: Alaba and Alaba (2003)

Disease has a significant negative impact on household as well national economy of the endemic countries. Microeconomic studies demonstrate that the direct and indirect costs of a single case of malaria deplete a significant portion of a household's income, increases morbidity and mortality among people of all ages, Caregivers absenteeism increases School attendance and academic performances decreases. This flow of the consequences of malaria from the micro level to the macro level is depicted in figure 1 modified by the author from Alaba and Alaba(2003). The figure summarizes the economic impact of malaria on both households and national levels.

3. Methodology

3.1 Sources of Data

The data for this study were sourced from the Central Bank of Nigeria (C.B.N) Statistical Bulletin (2022), the Federal Ministry of Health (statistical Division), Penn World Tables, World Health Organization and World Bank Development Index database as well as National Bureau of Statistics (NBS). The data on Malaria morbidity was sourced from The World Malaria Report (2022/3). The number of cases reported is adjusted to take into account incompleteness in reporting systems, patients seeking treatment in the private sector, self-medicating or not seeking treatment at all, and potential over-diagnosis through the lack of laboratory confirmation of cases

3.2 Model specification

The model to be estimated is specified below in an attempt to determine the impact of malaria prevalence on labour productivity in Nigeria. The inclusion of these explanatory variables for testing their impact on labor productivity growth is justified in literature (see Gallup and Sachs (2000); McCarthy and Wolf, (2000): and Asante *et al.*, (2003)

$$Lp = f(malaria, lbf, open, lexp, healthexp, gfcf) \quad \textbf{5}$$

Incorporating the variables into the Cobb-Douglas production function, we have:

$$Lp_t = A_t malaria_t^{\beta 1} lbf_t^{\beta 2} open_t^{\beta 3} lexp_t^{\beta 4} healthexp_t^{\beta 5} gfcf_t^{\beta 6} \quad 6$$

Adopting a log-linear specification, taking the natural logarithm of both sides of the equation and assuming linearity among the variables gives:

$$\ln Lp_t = \beta_0 + \beta_1 \ln malaria_t + \beta_2 \ln lbf_t + \beta_3 \ln open_t + \beta_4 \ln lexp_t + \beta_5 \ln healthexp_t + \beta_6 \ln gfcf_t + \varepsilon_t \mathbf{7}$$

Where: *t:* represent time period, the parameters $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, and\ \beta_6$are the coefficients of income elasticity for the inputs showing the percentage of labour productivity growth when these inputs are increase by 1%.

lp : denotes the labor productivity growth rate, measured as GDP per employed person (i.e. Gross Domestic Product (GDP) divided by total employment in the economy),

lbf: is the labour input (workers aged 15-65 years),

gfcf : is gross capital formation,

lexp: represents Life expectancy at birth, also a measure of the stock of human capital,

open: is openness which is defined as trade percentage of GDP,

healthexp: is government recurrent expenditure on health,

malaria: is an index of malaria obtained by dividing the annual reported cases of malaria morbidity by the projected population over the same period. The number of cases reported is adjusted to take into account incompleteness in reporting systems, patients seeking treatment in the private sector, self-medicating or not seeking treatment at all, and potential over-diagnosis through the lack of laboratory confirmation of cases.

Apriori expectations are as follows: the expected signs of the coefficients of the explanatory variables are: $\beta_0 > 0$, $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 < 0$, $\beta_4 > 0$, $\beta_5 > 0$, $\beta_6 > 0$.Note that, $\ln A_t = \beta_0$

3.3 Technique of Data Analysis

The Generalized Method of Moments (GMM)

The Generalized Method of Moments (GMM) was used to estimate the model specified in section (3.3). The formalization of GMM is usually attributed to Hansen (1982) and is regarded as a generalization of many other estimation methods like least squares (LS), instrumental variables (IV) or maximum likelihood (ML). As a result, it is less likely to be mis specified. The properties of the estimators of LS depend on the exogeneity of the regressors and the circularity of the residuals, while those of ML depend on the choice of the likelihood function. Generalized Method of Moments

(GMM) estimator is a robust estimator and much more flexible since it only requires some assumptions about moment conditions. GMM estimates rely on the absence of autocorrelation in the level's residuals. Because it does not impose any restriction on the distribution of the data, GMM represents a good and reliable estimation procedure for the model specified in section 7.

The approach is therefore, to estimate the model, using a set of instruments. To ensure that the GMM estimator is identified, we have the same number of instrumental variables as the parameters to be estimated. Thus, we use economic conditions such as Labour Productivity (*Lp*), Life expectancy (*lexp*), and the lagged values Malaria Index (*Mal*), Gross Domestic Product (*GDP*)and health expenditure (*healhexp*) as instruments. The instruments are the one period lag of the variables.

4. EMPIRICAL ANALYSIS AND DISCUSSION AND FINDINGS

Descriptive statistics

Descriptive statistics of sample data on Table 4.1 shows that the average malaria morbidity rate is 0.017 and average labour productivity growth (*Lp*) rate in Nigeria is -0.062. Life expectancy has average value 47.2 and openness of the economy has average value 76.3. The table also shows that government expenditure on health average 36261.9 while the average mortality rate is 183.9.

Table 1: Summary of Descriptive Statistics

Variables	N	Mean	SD	Min	Max
Malaria	21	0.0173	0.00634	0.01	0.03
Lp	21	-0.0622	0.29420	-1.00	0.37
Life expectancy	21	47.2065	2.12286	45.12	50.95
Openness	21	76.3181	8.26651	64.42	97.32
Healthexp	17	39132.3365	36261.94091	150.16	102620.00
Mortality rate	21	183.9333	24.39492	142.90	213.00

Source; author's computation

The result above implies that government expenditure on health (*healthexp)* in Nigeria tend to be the most serious problem given its highest average value as suggested by mean. The result is further supported by the standard deviation value which gives dispersion around the mean. *healthexp* has the highest value of standard deviation, showing that despite the prevailing level of government expenditure on health, controllable diseases such as malaria is rapidly increasing.

Table 2: Unit Root Test Results

Variable	*ADF*	*c-value of ADF*	*PP*	*c-value of PP*	*Comment*
Lp	-3.7418*	-3.0294	-10.9672**	-3.8067	I(0)
Malaria	-3.7641*	-3.0400	-6.8283**	-3.8304	I(1)
Rgdp	-5.6762**	-3.8572	-5.0490**	-4.5348	I(1)
Lexp	-3.5144*	-3.0294	2.5957**	-2.6889	I(0)
Lbf	9.4854**	-2.6857	9.4854**	-2.6857	I(0)
Gfcf	4.0680**	-3.8304	12.9637**	-3.8067	I(0)
Open	-4.8847**	-4.5348	-4.2858*	-3.6591	I(0)
Healthexp	-4.8606**	-4.5743	-5.6501**	-4.5348	I(1)
Mr	-4.0406*	-3.6746	-6.6506**	-4.5000	I(0)

Source: Author's Computation
Note: For the levels, I included trend and intercept, as the line plots of the series indicate and also For their first differences. (*) and (**) indicate the rejection of unit root at 5% and 1% respectively.

The results of the stationarity test of the variables in Table 4.1, using the ADF unit root test shows that all the variables are stationary at levels except *Malaria*, *Rgdp* and *Healthexp* were stationary at first difference.

Impact of Malaria on Labour Productivity in Nigeria

The result reported in Table 4.3 showed that the estimated coefficients are statistically significant. However, the coefficients of lagged log*Lexp* and Log*Gfcf* are insignificant in explaining variations in labour productivity (*Lp*). The higher R^2 value of 0.986 indicates that 98.6% of variations in the dependent variable (*Lp*) is accounted for by variations in the independent variables.

However due to the limitations of the DW test, the Ljung-Box Q-statistic was used to test for the presence of serial correlation among the residuals. and the result indicated the absence of serial autocorrelation in the residuals.

Table 3 GMM Regression Results
Dependent Variable: *Labour Productivity (Lp)*

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
logMalarria(-2)	-0.907***	0.0391	-23.1987	0.0000
Loglbf	-0.336**	0.1013	-3.316761	0.0056
logLexp(-2)	0.224	0.2667	0.8383	0.4170
logHealthexp	0.016**	0.0069	2.36760	0.0341
logOpen	-0.153	0.0798	-1.9141	0.0779
logGfcf(-2)	0.026	0.0159	1.66213	0.1204
R^2	0.986413			
R^{-2}	0.980142			
J- statistic	*0.020573*			

Source: Author's Computation

Note: For the levels, I included trend and intercept, as the line plots of the series indicate and also for their first differences. (**) and (***) indicate the rejection of unit root at 5% and 1% respectively.

The coefficient of the malaria index, *Log (Malaria)* had the expected negative sign and strongly statistically significant at the 1% level. This reveals a negative and significant effect of the lagged malaria variable on labour productivity i.e. a one percentage increase in malaria morbidity rate results in a decrease in labour productivity growth by 0.91%. This is in line with the theoretical expectations. Malaria morbidity reduces output by increasing absenteeism from work, and by reducing work capacity or effort. This result is consistent with the findings of previous studies that there exist significant negative association between malaria and economic growth, by Gallup and Sachs (2001), McCarthy *et al*, (2000) Asante *et al,* (2003).

Life expectancy a positive coefficient (which was expected) but is not statistically significant. This implies that there is a potential that the increase in life expectancy will lead to increase labour productivity. The stock of labour input, *Log(lbf)* has a negative coefficient which was not expected, but is statistically significant at the 10% and 5% levels, respectively. On the other hand, The coefficient of the stock of capital input proxied by *Log(Gfcf)* has a positive sign but it's not significant. However, this reveals that *Log(Gfcf)*(*lagged* twice) has the potential to impact positively on labour productivity in Nigeria.

The coefficient of health expenditure, *Log (Healthexp)* had the expected positive sign and statistically significant at the 10% and 5% levels, respectively. This implies that a percentage increase in government recurrent expenditure on health will results in an increase in labour productivity by 1.6%. This is in line with the theoretical expectations.

5. CONCLUSION AND RECOMMENDATIONS

From the results of the analysis the study concluded that there is a link between increasing levels of malaria infections and the low levels of labour productivity in the country. This is because empirical evidence from the estimated model found significant negative impact of malaria on labour productivity in Nigeria.

The specific policy recommendations that can be made from the findings of this study include: Government should ensure increased access to healthcare services for all citizens to reduce the prevalence of malaria in the country. There should be an increase in government financing on malaria prevention and control which will ensure that the poor have access to essential health interventions aimed at preventing, treating and controlling malaria. Concerted efforts must be made by government to attract international donor agencies into the country so as to effectively combat the menace of malaria on the national economy.

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