Modeling the effects of health care expenditure and economic growth in Nigeria: An econometric analysis

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Abstract

Literature abounds that labor quality, in the form of human capital, clearly contributes significantly to productivity growth, but very few analysts have been interested to locate potential human capital growth outside education. Such interest will help ascertain the effectiveness of public health expenditure on health and the impact of good health to economic growth in Nigeria. This research empirically attempts to analyze health outcome and economic growth; proxied by life expectancy at birth and gross domestic product per-capita respectively using quantitative analysis. To avoid the possibility of encountering simultaneity error, we use the three stage -least -square (3SLS) regression to estimate the result. The result shows simultaneity between health outcome and economic growth. The results equally show that health expenditure is significant in determining health outcome but has no significant relationship with economic growth. As a recommendation government must increase budgetary allocation to the health sector and effectively monitor its utilization.

Keywords: *Economic growth, Life expectancy, Health outcome*.

JEL Classification: H51, H53, II8, O1, J24

INTRODUCTION

An increase in healthcare expenditure contributes to human capital development which also leads to increase in the productivity of labour. Although literature abound that labor quality, in the form of human capital, clearly contributes significantly to productivity growth, yet very few analyst have shown interest to locate potential human capital growth outside education. This practice has a tendency to overlook the need to consider health as a critical aspect of human capital, and therefore an important determinant of economic growth. Meanwhile the debate has not subsided as to the real outcome of health expenditure, as some researchers (Bokhari et al, 2007; Rajkyman & Swaroop, 2007) posit negative effect on economic growth.

Healthier workers are mentally sound and physically more energetic and robust. They are more productive and by implication earn higher wages, all things being equal. They are also less likely to be absent from work because of illness (Bloom et al 2004). Health, in the form of life expectancy, has appeared in many cross country growth regressions, and investigators generally find that it has a significant positive effect on the rate of economic growth (Bloom &Canning, 2000, 2003). It is worrisome that even with this background knowledge in third world countries little attention is paid to people's welfare in terms of health care maintenance (Eric Arthur and Hassan E. Oaikhenan,

2017). It is equally appalling that most of these countries in Africa spend enormous income in health tourism. Nigeria with a population of about 170 million people is a typical case to consider. The expenditure pattern of Nigeria shows that only paltry amount is budgeted for health care yearly. For example, in 1997, 4.6% of gross domestic product (GDP) is accounted to have been spent on healthcare. The figure rose to 6.6% in 2005 and later fell to 5.8 in 2009. Much of what is known about health care in Nigeria is the Out-of-pocket health expenditure otherwise known as pay at point of service. About 70% of Nigerians settle their health expenses through this process far above 20 percent maximum of the World Health Organization (WHO) (Ichoku et al,2009). Public financing of healthcare in Nigeria is inadequate. The foregoing may suggest that most governments in Africa and in particular Nigeria have not sufficiently understood the relationship among health, its outcome and economic growth (Jacob et al., 2018 and Olufunmilayo, 2018).

The neoclassical growth theory of Robert Solow (1956) and Swan (1956), perhaps may have lost intellectual appeal or rather could be said to be insufficient anymore in explaining the technological progress of the production function. It is the new growth theories - Lucas (1988) and Romer (1990), Mankiw et al (1992) etc., that have expanded and expounded the growth model to include knowledge capital, skills and experiences owned by labour. Thus growth became a function of human capital and not physical capital only. Regrettably, human capital development has necessarily been associated with the level of one's education and sparsely health. Most researchers see health as playing a passive role in human capital index, and therefore take a cursory view of it as an important component of Human Capital Development (HCD). However, recent studies -McCoskey (1998), Carrion-I-Silvestre (2005), and Narayan 2006) have found health as a significant factor to be included in a growth model. Health as human capital affects growth directly through, for example, its impact on labour productivity and the economic burden of illness Bloom and Canning (2003).

Empirically, research on the results of government spending on health is abounding though mixed (Barro, R. (1996), Hamoudi, A., & Sachs, J. (1999), Sachs, J., & Warner, A. (1997), but it is heavily skewed toward positive outcomes from increased public spending. Empirical findings such as: Kim Tae and Lane Shannon (2013) with data from 17 OECD countries between 1973 and 2000, found a statistically significant association between government health expenditure and public health outcomes and further findings show a negative relationship between government health expenditure and infant mortality rate, and a positive relationship between government health expenditure and life expectancy at birth.

Onisanwa (2014) for Nigeria, show that Health indicators have a long run impact on economic growth; Boussalem et al (2014) for Algeria, found there is a long-run causality from public spending on health to economic growth and no short run causality from public spending to economic growth. Bedir Serap (2016) found income level as the main factor in determining the level of healthcare expenditure. Other previous works on this include (see Bloom and Canning (2005); Narayan (2006); Huang (2009); Wang (2011) and Mehrara (2011). The few examples above may not suffice but it goes a long way to show that the effect of health on economic growth has not been settled empirically.

The main objective of this study is to include health in a well-specified aggregate production function in an attempt to determine the impact of healthcare expenditure on health outcome (Life expectancy) and determine the impact of health on economic growth (GDP per-capita) in Nigeria for the existence of an effect of health on labor productivity. We perceive a simultaneous equation problem (whether growth causes health or health

causes growth) because one of the endogenous problems may appear as an explanatory variable. Economic theory tells us if one or more variables are correlated with a disturbance term it becomes useful to apply a model of growth that will treat the simultaneity problem. Simultaneous equation model is best used when there is evidence of simultaneity among variables. This will help to check which one causes the other. On the basis of the above, ordinary least square (OLS) regression becomes insufficient and we therefore resort to the use of three-stage-least square (3SLS) regression. It becomes pertinent to measure the existing investment in health vis-a-vis its contribution to economic growth.

METHODOLOGY

We begin with the AK-model, which is an endogenous growth model, the model sums up physical and human capital accumulation into capital accumulation and does not make distinction between capital accumulation and technological progress. For this reason, there can never be disguised unemployment, i.e., marginal productivity cannot fall to zero. By the AK-model of the form: Y=AK, where Y=national income, K= stock of capital and A =constant returns to capital.

The econometric model approach employed by Nwanosike et al (2015) is adopted to analyze the inter-relationship between fiscal policy and economic growth in Nigeria based on their methodological relevance in explaining precisely, the growth effect on Nigerian economy. The adopted empirical studies models are formulated using the Solow growth theory which states that labour and capital affect economic output. The adopted econometric model is expressed as:

Y=F(H)

Thus, mathematically stated as:

$$Y = \alpha_0 + \alpha_1 H + \mu \qquad (1)$$

Where Y is health outcome, F is functional notation, a_0= intercept or constant; a_1= parameters or co-efficient of explanatory variables; and u = error term, H stands for health inputs. In line with economic theory, we added health expenditure, health policy and education into the health production function to determine their impact on life expectancy at birth. However, the empirical models adopted from the work of Bloom et al (2004) and Nwanosike et al (2015) is modified taking into consideration the main focus of this study, which is to determine the impact of healthcare expenditure on health outcome (Life expectancy) and determine the impact of health on economic growth (GDP per-capita) in Nigeria for the existence of an effect of health on labour productivity. Empirically, Anyanwu et al (2007) and Bakare et al (2011) have shown that health is affected by health expenditure, literacy rate and income per capita. Also Nwanosike et al (2015) used health production function to show the relationship between health outcome and health inputs.

Therefore, the empirical model for this study is specified as:

Model I: Impact of health expenditure on health outcome (life expectancy at birth)

$$\text{Leb} = f(\text{femedu}, \text{gdppc}, \text{ghe}, \text{co2em}) \qquad (2)$$

The Mathematical form of the model:

$$\text{leb}_t = \alpha_0 + \alpha_1 \text{femedu}_t + \alpha_2 \text{gdppc}_t + \alpha_3 \text{ghe}_t + \alpha_4 \text{co2em}_t \qquad (3)$$

Econometrically:

$$\mathrm{leb_t} = \alpha_0 + \alpha_1\mathrm{ghe_t} + \alpha_2\mathrm{gdppe_t} + \alpha_3\mathrm{logfemedu_t} + \alpha_4\mathrm{co2em_t} + \mathrm{v_{1t}} \ldots\ldots\ldots(4)$$

To take care of possibility of multi-colinearity, we take the log transformation of the variables. Thus:

$$\mathrm{logleb_t} = \alpha_0 + \alpha_1\mathrm{logghe_t} + \alpha_2\mathrm{loggdppe_t} + \alpha_3\mathrm{logfemedu_t} + \alpha_4\mathrm{logco2em_t} + \mathrm{v_{1t}} \ldots(5)$$

Where: $\mathrm{logleb_t}$ = log of life expectancy at birth, $\mathrm{logghe_t}$= log of government health expenditure, $\mathrm{logfemedu_t}$= log of female education, $\mathrm{loggdppc_t}$= log of gross domestic product per-capita, $\mathrm{logco2em_t}$= log of carbon-dioxide emission, α_0= constant, α_1, α_2,α_3 and α_4=structural parameters, $\mathrm{v_{1t}}$= noise that takes care of other variable that could affect health that are not in the model.

Model II: Impact of health outcome on economic growth

$$\mathrm{gdppc} = f(\mathrm{ghe, leb, gfcf, lfpr}) \ldots\ldots\ldots(6)$$

mathematically:

$$\mathrm{gdppc_t} = \beta_0 + \beta_1\mathrm{ghe_t} + \beta_2\mathrm{leb_t} + \beta_3\mathrm{gfcf_t} + \beta_4\,\mathrm{lfpr_t} \ldots\ldots\ldots(7)$$

Econometrically:

$$\mathrm{gdppc_t} = \beta_0 + \beta_1\mathrm{ghe_t} + \beta_2\mathrm{leb_t} + \beta_3\mathrm{gfcf_t} + \beta_4\mathrm{lfpr_t} + \mathrm{v_{2t}} \ldots\ldots\ldots(8)$$

log transformation of the variables:

$$\mathrm{loggdppc_t} = \beta_0 + \beta_1\mathrm{logghe_t} + \beta_2\mathrm{logleb_t} + \beta_3\mathrm{logfcf_t} + \beta_4\mathrm{loglfpr_t} + \mathrm{v_{2t}} \ldots\ldots(9)$$

where: $\mathrm{loggdppc_t}$ = log of gross domestic product per-capita; $\mathrm{loggfcf_t}$= log of gross fixed capital formation; $\mathrm{logleb_t}$= log of life expectancy at birth; $\mathrm{logghe_t}$= log of government health expenditure; $\mathrm{loglfpr_t}$ = log of labour force participation rate; $\mathrm{v_{2t}}$= white noise which takes care of other variables that are supposed to be in the model but are not. β_0=constant, β_1,β_2,β_3 and β_4 are the structural parameters.
Structural Form Model as below:

$$\mathrm{logleb_t} = \alpha_0 + \alpha_1\mathrm{logghe_t} + \alpha_2\mathrm{loggdppc_t} + \alpha_3\mathrm{logfemedu_t} + \alpha_4\mathrm{logco2em_t} + \mathrm{v_{1t}} \ldots\ldots(10)$$

$$\mathrm{loggdppe_t} = \beta_0 + \beta_1\mathrm{logghe_t} + \beta_2\mathrm{logleb_t} + \beta_3\mathrm{logfcf_t} + \beta_4\mathrm{loglfpr_t} + \mathrm{v_{2t}} \ldots\ldots(11)$$

Reduced Form Model

$$\mathrm{logleb_t} = z_{10} + z_{11}\mathrm{logghe_t} + z_{12}\mathrm{logghe_t} + z_{13}\mathrm{loggfcf_t} + z_{14}\mathrm{logffpr_t} + z_{15}\mathrm{logco2em_t} + \varepsilon_{1t} \ldots\ldots(12)$$

$$\mathrm{loggdppc_t} = z_{16} + z_{17}\mathrm{logghe_t} + z_{18}\mathrm{logfemedu_t} + z_{19}\mathrm{loggfcf_t} + z_{20}\mathrm{loglfpr_t} + z_{21}\mathrm{logco2m_t} + \varepsilon_{2t} \ldots\ldots(13)$$

The structural model has 10 parameters while the reduced form model has 12 parameters, thus it is over identified. Therefore three-stage-least-square (3SLS) estimation is appropriate for the study. A Priori Expectation: gdp>0, leb>0, ghe>0, gfcf>0,fem>0,lepr>0,C02<0**.**

Method of Data Analysis and Source of Data: Simultaneous equation model is best used when there is evidence of simultaneity among variables. This will help to check which one causes the other. Due to this, ordinary least square (OLS) regression becomes insufficient and we therefore resort to the use of three-stage-least square (3sls) regression. The 3SLS regression will give a result that is reliable for policy makers to fall back on. This is so as it will help to identify quickly if economic growth causes health or if health causes economic growth and whether policy makers should adopt policies to

improve health or to promote economic growth. The data for this study is obtained from secondary sources, particularly from Central Bank of Nigeria (CBN) publications such as the CBN Statistical Bulletin, CBN Economic and Financial Review Bulletin (2015) and data from World Bank economic indicator 2016.

FINDINGS AND ANALYSIS

Unit root test

Unit root test is a test conducted to check for the stationarity of time series variables. Stationary time series variables have mean and variance constant over the period. The null hypothesis is that there is no stationarity. But if the test-statistics is greater than the critical value in absolute terms we reject the null hypothesis. Table 1.1 below is the ADF unit root test. It shows that all the variables are stationary at first difference. That is, they are integrated of order one. The null hypothesis which is not supposed to be rejected if the critical value at 5 percent level was greater than the test-statistics is rejected.

Table 1. ADF unit root test result (1980-2015)

Variables	ADF test statistics (first difference)	Remarks (5% level of significance
GDPPC	-4.837	Stationary I(1)
LEB	-6.861	Stationary I(1)
FEMEDU	-9.328	Stationary I(1)
GHE	-6.154	Stationary I(1)
GFCF	-4.628	Stationary I(1)
CO2EM	-9.668	Stationary I(1)
LFPR	-3.974	Stationary I(1)

Source: author's computation from STATA 13

According to the result, we do not reject the hypothesis that there is stationarity, hence the ADF test statistics is greater than the critical value at 5% percent critical value.

Simultaneity test

According to the Hausman-specification test, the null hypothesis is that there is no simultaneity. If the coefficient of the residual is statistically significant we reject the null hypothesis of no simultaneity.

Table 2. Simultaneity Test

Variable	Coefficient	P-value
Residual	1.956711	0.004
R-Square	0.9681	
p-value of F-statistics	0.0000	

Source: STATA output; p-value in parenthesis

From the Table 2, the residual (resid) coefficient is statistically significant with a probability (0.000) less than 0.05. Thus we reject the null hypothesis of no simultaneity and proceed to use two-stage-least square as the most consistent and efficient estimator.

Regression result for life expectancy at birth

To achieve objective one which is to know the impact of health expenditure on health outcome, we ran the three-stage-least square regression. The result shows that 96 percent of health outcome (life expectancy at birth) is explained by the independent variables: gross domestic product per capital (GDPPC), female education (FEMEDU), public health expenditure (GHE) and carbon emission (CO2EM). This is as the

coefficient of determination is 0.9560. It also means that 4 percent of the life expectancy at birth is explained by other variables outside this model. The Chi2 probability is less than 0.05 this shows that the model of health outcome is statistically significant. Also GDPPC met the apriori expectation with a positive coefficient and it is statistically significant with a probability (0.000) less than 0.05 at 5 percent level of significance. This means that during the period covered by this research gross domestic product per capital had a significant impact on life expectancy at birth in Nigeria. This is in line with the findings of Onisanwa (2014). The value of the coefficient is 0.1142 which means that an increase in gross domestic product per-capital by one percent will increase life expectancy by 11.4 percent.

Table 3. Three-stage-least-square regression for life expectancy (LEB)

Variables	Coefficient	P-value
Log(GHE)	0.0058531	0.000
Log(GDPPC)	0.1142181	0.000
Log(FEMEDU)	0.2154653	0.301
Log(CO2EM)	-0.096328	0.323
R-Squared	0.9560	
P(Chi^2)	0.000	

Source: author's computation from STATA 13

Government health expenditure (GHE) follows the apriori expectations with the positive sign of the coefficient and it is significant with the probability (0.000) less than 0.05 at 5 percent level of significance. Thus public health expenditure impacted on life expectancy at birth in Nigeria during the period covered by this research. This is in line with the work of Anyawu et al (2007) and Bakare et al (2011), but against the work of Kim et al (2013). The coefficient value is 0.0058 that is an increase in health expenditure by one percent will increase life expectancy by 0.58 percent. This small percentage could be due to low health expenditure.

Female education (FEMEDU) coefficient is positive which is in line with the theoretical expectations. However it is statistically insignificant with probability value (0.301) more than 0.05 at 5 percent level of significance. This implies that female education had no significant impact on life expectancy in Nigeria throughout the period covered by this work. The coefficient is positive and equal to 0.2155 that is, an increase in female education by one percent will increase life expectancy by 22 percent.

Carbon emission (CO2EM) has a negative coefficient which is in line with the theoretical expectation. However, it is insignificant in determining life expectancy at birth. This might be related to the fact that Nigeria is not as industrialized as the developed world for carbon emission to affect the lives of its citizens. However, an increase in carbon emission by one unit will reduce life expectancy by 0.09 percent. Carbon emission had no impact on life expectancy at birth for the period covered by this work in Nigeria.

The 3SLS regression result for economic growth is presented in Table 4. From the result, the coefficient of determination is 0.9250. It means that 93 percent of economic growth is explained by life expectancy at births (LEB), government health expenditure (GHE), gross fixed capital formation (GFCF) and labour force participation rate (LFPR). The CHI^2 has a probability (0.0000) less than 0.05 at 5 percent level of significance; this means that the model of economic growth is statistically significant.

The coefficient of LEB is positive which is in line with the theoretical expectation. It is statistically significant with probability (0.000) less than 5 percent level of significance. This implies that life expectancy had an impact on per-capita GDP

in Nigeria over the period covered by this work. An increase in life expectancy by one unit will increase gross domestic product per-capita by 6.65 units.

Table 4. Regression result of per-capita GDP

Variables	Coefficient	P-value
LogLEB	6.65188	0.000
LogGHE	-0.326003	0.000
LogGFCF	0.0159897	0.342
LogLFPR	-0.8731544	0.291
R-Squared	0.9250	
P(Chi^2)	0.000	

Source: author's computation from STATA 13

Government health expenditure is statistically significant with probability (0.000) less than 0.05 and has a negative coefficient which does not follow the theoretical expectation. This implies that government health expenditure significantly impacted on per-capita GDP over the period covered by this work. The negative coefficient of -0.0326 implies that an increase in government expenditure by one unit reduces gross domestic product per-capita by 3.2 percent. And it could be possible that the negativity is caused by inequality in healthcare funding and corruption on the side of Nigerian government. This contradicts the work of Bakare et al (2011) who found a significant and positive relationship between health expenditure and economic growth.

Gross fixed capital formation coefficient is positive. This is in line with the theoretical expectation. But it is statistically insignificant to impact on gross domestic product person employed in Nigeria for the period under consideration. It is likely to be as a result of insufficient infrastructures and inefficient funding of capital project by Nigerian government. Thus a unit increase in gross fixed capital formation will increase gross domestic product by 1.6 percent.

Labour force participation rate coefficient is positive and it follows the apriori expectation, but it is statistically significant in determining gross domestic product per-capita in Nigeria as of the period covered by this work. However an increase in larbour force participation rate by one unit will increase per-capita GDP by 87 percent.

Summary of research findings

There is simultaneity between life expectancy at birth (leb) with gross domestic product per-capita. There is long and short run causality from life expectancy at birth and gross fixed capital formation to per-capita GDP. While there is only long run causality from government health expenditure and labour force participation rate to per-capita GDP, it follows the work of Beheshti et al (2008) who found only one long run relationship between health expenditure and economic growth in Iran. Further, there is long run causality from per-capita GDP, female education, and government health expenditure and carbon-dioxide emission to life expectancy at birth. This contradicts the work of Riman et al (2010).

Life expectancy has a positive and significant impact on economic growth in Nigeria. This can be observed by the significant nature of the variable as it has probability of 0.000 less than 0.05 level. Per-capita GDP has a positive and significant impact on health outcome in Nigeria, with a probability of 0.000 less than 0.05 at 5 percent level of significance. This is in line with the findings of Onisanwa (2014).

Health expenditure has a positive and significant impact on health outcome in Nigeria with the probability (0.000) less than 0.05 at 5 percent level of significance. This follows the works of Anyanwu et al (2009) and Bakare et al (2011), but against the

work of Kim et al (2013). Further, health expenditure has a negative and significant impact on economic growth in Nigeria, but can only exert long run causality to economic growth. This might be due to the fact that health expenditure are not properly channeled to the right source and as well as corruption in Nigeria. This is in line with the work of Eneji et al (2013) who found that government total health expenditure has a negative impact on gross domestic product. Female education is statistically insignificant with probability value of 0.323 more than 0.05 at 5 percent level of significance, however, an increase in female education by one percent will increase life expectancy rate by 22 percent.

CONCLUSION AND RECOMMENDATIONS

Conclusion

It is important to note that one of the objectives of this work is to determine the impact of health expenditure on health outcome, as well as ascertain the impact of health outcome on economic growth. The analyses show that health expenditure impacted on health outcome for the period covered and that it has a negative relationship with economic growth. Also, health outcome impacted on economic growth and vice versa. Therefore we conclude that there is bi-causality between economic growth and health outcome, arising from the presence of simultaneity. And that health expenditure has an impact on economic growth in Nigeria.

Recommendations

Nigeria should give more attention to improving health budget since good health is associated with productive capacity. Policy makers should focus on improvement of health if growth is to be sustained. Gas emission should be controlled further as it does not enhance health and growth

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APPENDIX

Apendix 1. Data for regression model

YEAR	LEB	FEMEDU	GDPPC	GHE	GFCF	CO2EM	LFPR
1980	45	43.493	1118.824	70000	36.23	13.7	55.64
1981	46	43.7	1080.717	80000	35.22	14.9	55.43
1982	46	43.588	1312.406	100000	31.95	15	55.81
1983	46	42.977	1603.407	80000	23	7	56.63
1984	46	43.035	1464.005	100000	14.22	5.6	56.56
1985	46	44.02	1398.523	130000	11.96	7.6	56.57
1986	46	44.289	1476.526	130000	15.15	8.6	56.45
1987	46	44.385	1312.593	40000	13.6	11.3	56.71
1988	46	42.413	1141.06	420000	11.87	11.2	56.74
1989	46	44.994	1195.211	580000	14.25	18.73	56.76
1990	46	43.194	1239.649	500000	40.12	19.61	56.964
1991	46	43.805	1362.265	620000	39.97	19.8	56.939
1992	46	44.118	1319.782	150000	38.97	18.3	56.898
1993	46	43.727	1292.471	3870000	38.77	17.9	56.845
1994	46	44.065	1286.834	2090000	44.97	16.9	56.78
1995	46	44.543	1266.518	3320000	40.4	15.27	56.704
1996	46	45.29	1231.511	3020000	29.82	26.21	56.601
1997	46	45.11	1261.141	3890000	35.22	26.56	56.478
1998	46	45	1264.512	4740000	38.33	28.51	56.333
1999	46	43.83	1266.779	16640000	36.39	26.92	56.164
2000	47	43.93	1241.287	15220000	35.33	16.97	55.968
2001	47	44.41	1274.931	24520000	41.34	14.1	55.732
2002	47	44.38	1297.931	40620000	6.33	13.9	55.458
2003	48	44.46	1313.375	33270000	7.94	13.93	55.14
2004	48	44.884	1412.904	34200000	12.99	19.13	54.774
2005	50	44.35	1841.611	55660000	44.44	17.51	54.911
2006	50	45.98	1856.225	62250000	39.8	21.87	55.054
2007	50	46.13	1956.689	81910000	63.43	23.4	55.203
2008	50	46.34	2035.831	98220000	89.9	21.49	55.353
2009	51	46.66	2106.743	90200000	89.24	23.54	55.502
2010	51	47.3	2193.445	99100000	120.27	21.96	55.646
2011	52	48.3698	2302.829	231800000	142.32	29.16	55.789
2012	52	48.36	2351.281	197900000	126.94	29	55.928
2013	52	48.7	2386.758	179990000	101.7	28.25	56.059
2014	52	49.21	2448.9	1959800000	17.24	29	56.181
2015	53	49.23	2535.068	2577720000	22.7	28	56.306

SOURCE: Authors compilation from the World Bank Development Indicator and Central Bank of Nigeria statistical bulletin.LEB= life expectancy at birth, FEMEDU=female education, GHE=government health expenditure, GFCF=gross fixed capital formation, CO2EM= carbon emission,LFPR=Lbour force participation rate.