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HOW IMPORTANT IS INCOME AND ENVIRONMENTAL QUALITY TO CHILD SURVIVAL IN TWENTY-FIRST CENTURY?

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ABSTRACT

Nigeria failed to meet the Millennium Development Goals' goal five of reducing child mortality to 55 deaths per 1000 live births by the year 2015. This ugly development happened amidst growing records of expanding average income for the economy. As a result, this study examined the impact of per capita income and environmental quality on child survival using the Autoregressive Distributed Lag (ARDL) model approach. Theoretically, the model was predicated on a model of endogenous mortality and life expectancy. Findings show that rather than income, child survival is instead linked to immediate past period's state of health, quality of society's environmental living conditions, and HIV prevalence among the under-five. In addition, global factors were revealed to increasingly become more significantly relevant to child survival. On the basis of this the study concluded that insignificant impact of income on child survival could be explained by the high degree of income inequality which made many households unable to afford healthy living conditions and has limited access to child medical care.

KEYWORDS: *Income, Environmental Quality, Child Survival, ARDL Model, Nigeria*

INTRODUCTION

Socio economic condition in Nigeria do not fare well when compared with those of the organization for Economic co-operation and Development (OECD) countries (Ichoku and Nwosu, 2011). Nigeria is a middle income, mixed economy and emerging markets, with expanding financial service, communication, technology and entertainment sectors which ranked it 26th in the world in terms of Gross Domestic Product (GDP) performance- the largest in Africa as at 2014. The country's GDP at Purchasing Power Parity (PPP) almost tripled – from $170 billion in 2000 to $451 billion in 2012, and $481 billion in 2015. Correspondingly, the GDP per capita doubled from $1400 in 2000 to estimated $2800 and $3200 in 2012and 2014 respectively. Unfortunately, in the midst of these growth performances are inadequate job creation, rising unemployment and widespread poverty. This development leaves a greater number of Nigerians in abject poverty, thus, unable to afford health care services and by implication, exacerbating an already precarious situation, leading to further deterioration of Nigeria's health care indices.

In the 2004 update, for instance, United Nations found that Nigeria lagged behind in the Millennium Development Goals (MDGs) of eliminating extreme poverty and hunger, reducing child and maternal mortality, and combating diseases, despite progress recorded in other areas. The country's record of improving Under-Five Mortality Rate (U5MR) is quite

discouraging, especially when compared with countries in the West African neighborhood. In the report, while countries like Benin and Ghana recorded a percentage reduction of about 51% and 48% in U5MR respectively, between 1960 and 2004, Nigeria recorded a dismal 3% improvement record (Laoye, 2007). Further examination of trend in U5MR in Nigeria shows that the projection of 55 per 1000 live births in 2015 became unattainable, as this particular indicator stood at 108 per 1000 live births as at 2015. Correspondingly, while average life expectancies for fellow African neighbors like Morocco, Cape Verde, and Rwanda stood at 75.5, 72.4 and 66.4 years respectively as at 2015, life expectancy for an average Nigerian in the same period was 53 years. Therefore, it becomes pertinent to empirically provide answers to existing link between income and child health, as well as examine the importance of environmental living conditions to child survival in Nigeria.

In theory, broader macroeconomic and social context generate social stratification that is, the sorting of people into dominant and subdominant socioeconomic status (SES), racial/ethnic and gender groups. This shapes individual level determinants, including behavioral, biological and psychosocial factors which in turn produce differential risks of, and inequities in health outcomes (Kim et al., 2013). Secondly, World Health Organization (2008) earlier pointed out that inadequate health facilities, lack of transportation to institutional cares, inability to pay for services and resistance amongst some population to modern health care are the likely key factors behind the country's high rates of maternal, newborn and child mortality and morbidity rates. However, when viewed from different perspectives, complex environmental issues are related to a range of socioeconomic factors, some of which have direct implication for health. Unhealthy living conditions (particularly in urban communities) have adverse consequences on individuals' health and quality of lives. As a matter of fact, this unhealthy state of affairs of the environment finds explanation from ecological perspectives. It is the activities of man that alters the ecological balance of the environment and creates an adverse health condition of the mother and child.

The focus of past Nigerian specific studies are different from the questions and objectives guiding this particular investigation. For instance, no Nigerian study examined the impact of place as a child-health outcome variable. Therefore, this study departs from existing Nigeria specific studies by examining the impact of per capita income on U5MR (as a health outcome variable). In addressing this objective, great emphasis was placed on the importance of living conditions of the environment as important child-health determinant. To the best of the knowledge of this study, no past Nigerian study has attempted to provide answers to these questions and bridging these literature gaps. Therefore, the main objective of this study is an examination of the impact of per capita income and environmental living condition on child survival in Nigeria.

In addition to this introductory section, the paper provides a summary of relevant literature in section two, section three examined the data and method of study. Next, section four presents the result, five deals with discussion of findings and section six finally concludes suggesting policy options.

BRIEF EMPIRICAL LITERATURE

Internationally, the directions of existing literature on the income-health relations are drawn along distinct lines. Earlier investigations were aimed at either to uphold or overturn claims of an existing relationship between per capita income and health (Preston, 1975). Pritchett and Summers (1996) added a causal dimension to this established relation, which was subsequently supported by Hammer et al, (2003) and Cutler et al, (2006). Against the backdrop that income is not the only factor that shapes the world's health status, Javadipour and Mojtahed (2005) acknowledged that income plays

the most crucial role in shaping levels of health. Specifically, Hammers et al (2003) and Bokhari et al (2006) provided evidence linking U5MR and maternal mortality rates. A more recent study in the context of Sub Saharan Africa by Asiedu et al (2015) provided further evidence that per capita income improves health outcomes, and the effect is stronger at higher levels of income.

Among Nigerian specific studies, some focused on inequality in the provision of health care (Ibiwoye and Adeleke, 2008), Ichoku and Fonta (2006, 2009) carried out investigations into the redistributive effect of health care financing. Some other studies were on the demand for healthcare (Ichoku and Leibrandt, 2003; Onwujekwe and Uzochukwu, 2005; Amaghionyeodiwe, 2008). Yaqub et al (2012) examined the impact of expenditure and corruption on health outcomes. The study by Ichoku and Nwosu (2011) was on social macroeconomic determinants of health and health inequity; the study has a micro foundation. On the other hand, Senbanjo et al (2016) examined dietary practices and nutrition status of under-five in rural and urban communities of Lagos state. The study found no difference in diversity of food choices and frequency of consumption between urban and rural communities. Most recently, Kinsley, (2017) examined socioeconomic determinants of under-five health outcomes among childbearing mothers in Abia state. Findings indicate that, income and asset increase the probability of purchasing health promoting products for the child. The few Nigerian studies that focused investigation on the impact of income on child health were micro-based state level studies; results from these studies cannot be generalized for the entire economy. Secondly, no Nigerian study examined the impact of environmental living conditions on child health.

DATA AND METHODOLOGY

The data for the study are secondary data which span over the period 1986 to 2015. Each of the data set was extracted from the World Bank's Development Indicators for Nigeria, for the year 2015. The study's adopted measure of child mortality is mortality of children under the age of five – i.e., U5MR. It incorporates the mortality rate of children at various stages of the child's life, under the age of five. Furthermore, complex environmental issues are linked to the activities of human and other living organisms a number of which give rise to environmental hazards which have adverse consequences on health. Sanitation is a human mechanism for dealing with the dangerous consequences of these hazards. The degree of the adequacy of this defines the quality of living conditions in any given environment. On the other hand, its inadequacy has been identified as a major cause of disease world-wide (WHO, 2017). The study adapts sanitary condition of the society as proxies for environmental quality. This factor-in the hygienic condition of the environment where the child is nurtured, as well as mothers' personal hygiene.

Theoretical Framework and Model Specification

A theoretical basis of analysis of income-health relation herein is drawn from a model of endogenous mortality and life expectancy. In this, child quality is modeled as child expenditure. Increased health expenditure for the child, translates to higher probability of survival of the child to adulthood. Health expenditure is a function of income. Therefore, as income increases, parents invest more in child quality and this reduces child mortality, thereby increasing the chances of the child surviving to adulthood.

Drawing from the optimization problem of parents given their utility function and corresponding budget constraint, and following Strulik (2004) and Asiedu et al (2015), an equation that explains the child survival rate is derived thus:

$$\rho(q_t) = \Theta + (1 - \Theta)\, \rho_o(q_t)^{\mu} \quad (1)$$

Where θ ϵ(0,1), μ ϵ(0,1), and ρ ϵ(0, ρ). In it, the parameter θ captures the component of the survival rate that is not directly controlled by parents. μ captures the effectiveness of child quality in increasing the child survival rate. The optimal child quality, denoted by q* is specified as:

$$q^* = \frac{\rho_o}{n_0}\left(\frac{\varphi - \alpha(1-\mu)}{\varphi + (1+p)(1-\mu)}\, y1\right)^{1/(1-\mu)} \quad (2)$$

It is assumed that φ > α (1-μ). Under this assumption, q* is clearly positive. With the optimal q*, the restriction that the survival rate is less than 1, ρ (q*) < 1 yields the value for ρ (the upper bound):

$$\rho = \frac{n_o}{y}\left(\frac{\varphi + (1+p)(1-\mu)}{\varphi - \alpha(1-\mu)}\right)^{\mu} \quad (3)$$

From this, child mortality rate is derived and specified as:

$$1 - \rho(q^*) = 1 - \rho_o\,(q^*)^{\mu}. \quad (4)$$

By totally differentiating equation (1) with respect to income (y), Effect of an Increase in Income on Child Mortality Rate is derived, thus:

$$\frac{dq^*}{dy} = \frac{\rho_0}{n_0}\,\frac{\varphi - \alpha(1-\mu)}{\varphi + (1+p)(1-\mu)}\,\frac{1}{1-\mu}\,(q^*)^{\mu} > 0, \quad (5)$$

From equation (5), (6) is derived, thus:

$$\frac{d(1-\rho(q*))}{dy} = -\rho_0 \mu\,(q^*)^{\mu-1}\,\frac{dq^*}{dy} < 0. \quad (6)$$

Equation (6) shows that when income increases, parents invest in child quality. Investment in child quality reduces child mortality; that is, increases the chances of the child to survive to adulthood.

Equation (6) is transformed into an empirical model of the impact of per capita income, and environmental quality on child mortality. In dynamic econometric form, it is as specified :

$$\text{logH-th}_t = \alpha_0 + \alpha_1 \text{logH-th}_{t-1} + \alpha_2 \text{logGDPC}_t + \alpha_3 \text{logGDPC}^2_t + \alpha_4 \text{logHIV}_t + \alpha_5 \text{logSAN}_t + \alpha_6 D2 + \alpha_7 D3 + \mu_t \quad (7)$$

Where log is natural logarithm, μ stands for error term, t for time parameter, while α_1, α_2, α_3, α_4, α_5, α_6 are the coefficients of one period lag value of H-th (proxy for child mortality rate), per capita GDP, per capita GDP square (control for the curvilinear aspect of income-health relation), HIV/AIDS prevalence among children (proxy for health shock), level of sanitary condition of the society (proxy for environmental living condition, i.e, environmental quality), D2 and D3 (time dummy variables – control for global factors as defined by advancement in medical technology and its diffusion) respectively. A priori expectation is that α_3, α_4, > 0, while α_2, α_5, α_6, α_7 < 0. α_1 could be greater or less than zero, depending on the state of the child's previous mortality.

RESULTS

Variables in the model are macroeconomic aggregates, which are known to exhibit random-walks in their behaviors. Regression models using these aggregates in their non-stationary state are prone to spurious result outcomes, and they will be biased towards finding a reliable significant relationship among variables. To overcome this undesirable outcome, the study examined the stationary properties of the variables in the model, by means of the Augmented Dickey-fuller (ADF) stationarity test statistics. The result is presented in table 1.

Table 1: Results of Augmented Dickey-Fuller Stationarity Test

Variables	ADF Statistics	1% Critical Value	Order of Integration
LOGH-th	-5.971019	-3. 689194	I(0)
LOGHIV	-5. 454836	-3.737853	I(0)
LOGGDPC	-5.682866	-3.689194	I(1)
LOGSAN	-7.650415	-3.689194	I(1)

The result of the ADF test shows that H-th and HIV are stationary at their level form (ie is integrated of order zero I (0)). On the other hand, GDPC and SAN are integrated of order one (I (I)), therefore, should enter the model in their growth forms. The mix in the order of integration of the variables between zero and one necessitated the use of ARDL bound test for co integration. Based on the Akaike information criterion, ARDL (2,1,0,1,1) was selected. The coefficient of multiple determinations (R-squared) of 0.99 indicates a very strong explanatory power of the regression model. Authoritatively, Nau, (2017) recently argued that the predictive power of a time series model (where the variable to be predicted is a time series) is derived from the dependent variable's own history via lags, differences, and/or seasonal adjustment. The implication of this is the fact that, 99 per cent of changes in under-five mortality were actually explained by the set of explanatory variables. F-statistics value of 273232.2 (with a probability value of 0.0000) shows that the explanatory variables are non-zero at 95 per cent level of confidence. This means that, the entire regression model is statistically significant. Durbin Watson statistics value of 2.3 indicates the absence of autocorrelation of any order (see table 2).

Table 2: Short and Long Run Regression Model Results

Short Run Model				Long Run Model			
Variable	**Coefficient**	**T-Stats**	**P-Values**	**Variable**	**Coefficient**	**T-Stats**	**P-Values**
DLOG(H-th_1)	0.825063	-16.06	0.0000				
D(LOGHIV)	-0.007747	-1.25	0.2306	LOGHIV	-0.216728	-2.85	0.0117
D(LOGGDPC)	-0.003248	-0.70	0.4951	LOGGDPC	0.310707	0.71	0.4892
D(LOGGDPC^2)	-0.000321	-0.87	0.3977	LOGGDPC^2	-0.024541	-0.68	0.5075
D(LOGSAN)	-0.073504	-0.45	0.6594	LOGSAN	-49.503570	-1.95	0.0696
D(D2)	-0.002348	-3.13	0.0064	D2	-2.224548	-2.37	0.0310
D(D3)	-0.002802	-2.55	0.0216	D3	-0.268040	-2.53	0.0225
Ect(-1)	-0.010455	-4.48	0.0004				
R^2 0.99 Adjusted R^2 0.99 F-Statistics 273232.2 D-Watson 2.30							0.0000
JB Statistics 0.780777 Breusch-Pagan Hetroscedasticity 0.2.889415 Breusch-Godfrey LM 0.351608 Ramsey Reset 2.063146							0.676794 0.0266 0.7096 0.0569

Table 2 presents results of short run and long run regression models. The short run results show that four of the explanatory variables (H-th_1, GDPC, GDPC2, and SAN, including the time dummies) conform to theoretical expectation; HIV did not conform to the expectation of the theory. Among these variables, only the individuals' previous states of health and time dummies are statistically significant at 5 per cent level of significance. The error correction term Ect_{t-1} i.e., ContEq(-1) is negative and statistically significant with 1.1 percent speed of adjustment. The long run results show that, two of the explanatory variables (HIV and SAN) in addition to the time dummies are statistically significant at 5 percent level. $GDPC^2$, SAN and the time dummies have the right signs while, HIV and GDPC do not.

Diagnostic Tests

The results of the diagnostic tests show that, the model is normally distributed; Jarque-Bera (JB) test for normality shows that the error term is normally distributed at the 5% level of significance, given JB statistics of 0.780777, with a probability value of 0.68. Also, the model passed the Ramsey Reset test for misspecification, and serial correlation tests. Probability value of 0.0569 for the RESET test indicates failure to reject the null hypothesis, meaning that the model does not suffer from misspecification bias, while Breusch-Godfrey LM tests statistics also failed to reject the null hypothesis. CUSUM and CUSUMSQUARE tests show a very high degree of stability in the coefficients; the plot of the CUSUMSQUARE statistics remained within 5% significance bound, but, that of CUSUM showed a minimal level of the unstable state towards the last three periods of the study which is negligible (see figure 1 of the appendix). On the other hand, Breusch-Pagan hetroscedasticity test rejects the null hypothesis of no hetroscedasticity. This is not unexpected given the mix order of integration of the relevant time series data between zero and one, ie I (0) and I (1). Under this condition, it is natural to expect hetroscedasticity, hence the result (Mano-Bakalinov, 2016).

DISCUSSIONS OF FINDINGS

An important revelation from the analysis is the fact that the main variable of interest (GDPC) reduces child mortality in the immediate; child mortality reduces by 0.3 per cent, for every 1 percent increase in per capita income. This subsequently increases to 31.1 per cent in the long run. On the other hand, the squared form of the aggregate ($GDPC^2$) which captures the concave aspect of the relation reduces child mortality by 0.03 per cent (in the immediate) for every 1 per cent increase in the aggregate; the magnitude of this impact increases to 2.5 per cent in the long run. But their individual impacts are statistically insignificant in accounting for rates of changes in the mortality of the child. However, it should be noted that in the study, we employed aggregate data which provide information on average income, but no information on how the available income is distributed across individuals in the society. A few wealthy individuals may have a large chunk of the reported income, while the majority of the population has no reasonable level of income with which to access health services for the child. Under this circumstance, the society is bound to experience increasing rate of child mortality in the midst of enormous wealth – that seems to explain the Nigerian scenario. From a different perspective, it could be that child survival finds more explanation on the growing number of health intervention programs rather than income, such that the impact of the aggregate becomes insignificant. In Nigeria, medical care is mainly financed through out-of-pocket payment. Under this circumstance, and where households cannot afford the costs of medical care, they rely heavily on available child health intervention schemes.

Furthermore and with respect to environmental quality (environmental living condition) proxied in the study by the sanitary condition of the environment and behavioral characteristics of nursing mothers; 1 percent improvement in

living conditions of the environment reduces mortality rate by 7.4 per cent in the immediate. This subsequently increases to 4950.4 per cent in the long run; the short run impact is insignificant, as against strong significant long run impact. This outcome establishes environmental living conditions as most important child health determinant in Nigeria. The implication of this is that, the society must imbibe good sanitary habits, and the system should be alive to its responsibility of providing the population with improved sanitation facility, at least to a certain threshold sufficient to sustain life. When this is not the case, children are the age group that is more vulnerable to its adverse health consequences. The Sanitary condition of Nigerian society constitutes serious health hazards. In Nigeria, it is common to see people defecate in the open, and this has adverse consequences on human life, especially the child.

The insignificant impact of income necessitated the inclusion of time dummies to capture the impact of global factors in the model. Global factors are defined by medical-related technological progress, and diffusion of this progress to all parts of the globe. This plays a significant role in the survival of the child to adulthood than it has impacted on any other age bracket; result in analysis herein is consistent with this notion. The result revealed negative significant impact of global factors on child mortality. It means that medical technology progressively enhances the survival of the child; 1 per-cent increase in medical technology and its access in Nigeria through diffusion significantly, reduces child mortality in the immediate by 0.2 per cent within the period 1996-2005 and 0.3 per cent over the period 2006-2015. The impact subsequently increases in magnitude to 222.5 per cent and 26.8 per cent in the long run over the same periods respectively. This improvement can be attributable to more coverage for health intervention services provision targeted at the child, and the fact that more mothers are imbibing the habit of immunizing their children against notable health risks.

Among other control variables, the level of mortality rate of the child in the preceding period (H-th_1) significantly worsens the chances of survival of the child in the immediate. It did not come as a surprise that H-th_1 worsens child survival; instead the rate at which it does this (82.5 per cent) is worrisome. It is common for an individual's condition of health in the current period to be negatively influenced by already existing bad state of health, hence the result. Considering the variable HIV; its prevalence reduces child mortality by 0.8 per cent in the immediate and 21.7 per cent in the long run. The impact is insignificant in the short run, but significant in the long run. This outcome is an indication that anti retroviral treatment for children born with HIV is yielding positive result and should be reinforced.

CONCLUSIONS AND POLICY OPTIONS

This study was embarked on giving dearth of studies empirically examining links between income and health of the population at country level in Nigeria. The focus of most Nigeria studies were health financing and demand for health; in the attempt to examine the relationship between income and health, the aspect of health in focus in this study is child mortality. The choice of this is part of effort to unravel the mysteries behind Nigeria's inability to meet MDG goal 5 of reducing child and maternal mortality to 55 deaths per 1000 live births by 2015. In undertaking this task, the importance of environmental living condition was critically examined amongst other traditional determinants of health. This was part of efforts to ensure that results from the study are not only valid but reliable for policy.

Findings from the analysis that followed revealed that previous condition of child's health, environmental living condition, HIV prevalence, and global factors were significant in explaining changes in levels of child mortality, hence the rate of child survival. The contribution of income to child survival is insignificant. Such interesting discovery leads to introduction of time dummies in the model to capture impacts of global factors. The aim was to observe to find out whether

that could change the result; it did not change either. An interesting addition is the fact that global factors were revealed to have a progressively reducing impact on child mortality – and it is significant. This revelation is consistent with Asiedu et al (2015) findings for developing countries. A development as this makes a statement of the importance of health intervention schemes that are targeted at child survival to adulthood. It also makes a statement of the fact that nursing mothers in Nigeria are gradually and progressively keying into these schemes.

The observed insignificant impact of per capita income on child survival finds explanation on the high degree of income inequality which made many households unable to afford healthy living conditions and have limited access to medical care for the child. The greater number of Nigerian parents is so poor that they are unable to afford life promoting health services for the child. Under this circumstance, the only available option for child survival is child health intervention schemes. A significant proportion of these schemes are provided by foreign donor agencies. As a matter of fact, the high child mortality rate is occasioned by widespread income poverty among parents. Available child health schemes need be, supplemented and complemented by self help efforts. Much needed self effort are not forthcoming because, greater numbers of parents are poor, so, unable to access health services for the child; poor living condition of the society has not helped matters either. For solution, a well thought-out income distribution policy that can ensure a transfer of income and wealth from the rich to the poor, could serve as a panacea for these problems. To this end, the study recommends a variant of the "Obama healthcare" program for Nigeria. This shall complement other income distribution measures and facilitate transfer of income in the direction of low income quintiles, so as to enhance their ability to access medical care when needed. Furthermore, the government should step-up its awareness campaign and sensitization on the dangers of known child killer diseases, and the efficacy and availability of immunization services to deal with them. Most importantly, the government should step-up efforts at ensuring a clean environment. This can be achieved through making the municipal services of the government more efficient. It can be made more efficient if low-income settlements are upgraded, as well as redesigning of urban drainage architecture to make it more functional. In addition, existing laws compelling house owners to provide functional sanitation facilities in their houses should be strictly enforced.

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APPENDIXS

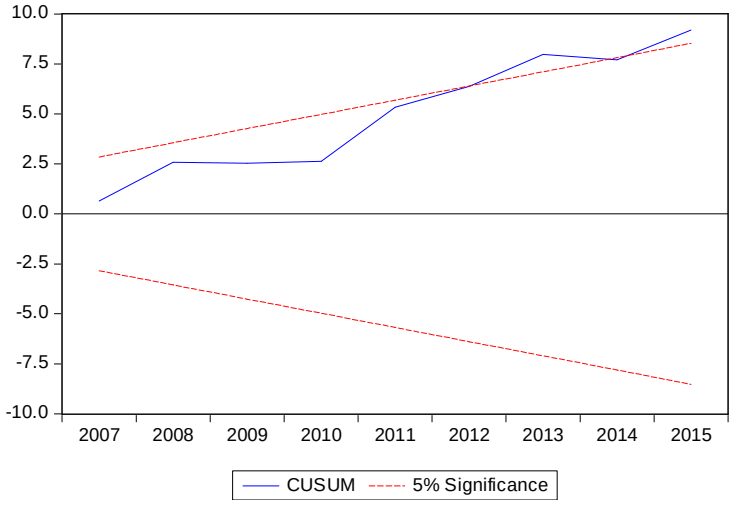

Figure 1: Stability Test

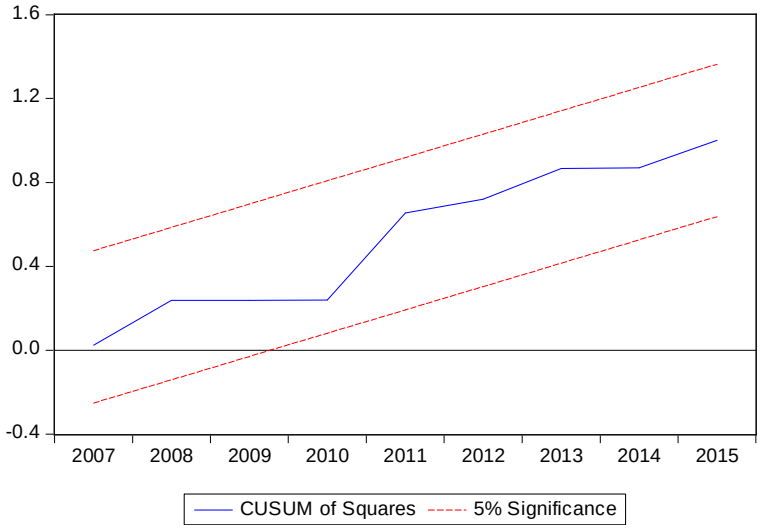

Figure 2