SOCIAL INFRASTRUCTURE AND INFANT MORTALITY IN NIGERIA

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Abstract

Given the prevalence of preventable infant mortality in Nigeria and its attendant consequences on future human capital development, this paper examines the relationship between social infrastructure and infant mortality in Nigeria from 1980 to 2017. The data for the study were collected from World Bank and World Health Organization data bank. The Johansen cointegration and error correction mechanism were adopted. Augmented Dickey Fuller (ADF) test was used in testing the stationarity of the variables and the test result shows that they are all integrated at order one. The Johansen cointegration result buttressed the existence of long-run relationship among the variables. The Granger causality test result show that unidirectional causality exist between female secondary school enrolment (FSE) and infant mortality (IMR). The same is applicable to female tertiary institution enrolment (FRT) and infant mortality. The parsimonious result established that a negative relationship exist between social infrastructure and infant mortality. Thus, the paper recommends increase female education enrolment.
Keywords: *Social Infrastructure and Infant Mortality.*

Introduction

A reduction in infant and child mortality by two-thirds from 1990 to 2015 is the fourth cardinal goal in the Millennium Development Goals (MDGs) (UNICEF, 2006). The rate of infant mortality in developing countries is relatively higher than that of the developed countries such as, United State of America, Canada and France . In sub-Saharan Africa one in every eight children die before reaching their first birthday. This is fourteen times higher than the risk for children in the developed countries (World fact book, 2018). The high incidence of infant mortality rate in sub-Saharan Africa is alarming

and mind boggling because it portrays a bad omen for future human capital development in the region. UNICEF (2010) pointed out that, 8.1 million children that died in the world in 2009 before their fifth birthday were in developing countries and that they died from diseases that were preventable.

Infant mortality rate is one of the key indicators that defines the health status and quality of life of any given country. Given the high rate of preventable infant mortality in Nigeria, in October 2008, the Nigerian Government's National Health Insurance Scheme (NHIS) was launched in October 2008 (Bello & Joseph, 2014 & Bako, 2017). The policy thrust of the programme is reducing maternal and child mortality in the country. Despite the huge resources committed to this programme, Nigeria still has the third highest infant mortality rate in the world (WHO, 2017). About 10 percent of infant mortality in the world in 2017 occurred in Nigeria. UNICEF (2017) report documented that five countries accounted for half of infant mortality in the world in 2017 and Nigeria is third on the list. These countries in their descending order were India (24 percent), Pakistan (10 percent), Nigeria (9 percent), the Democratic Republic of Congo (4 percent) and Egypt (3 percent). Nigeria infant mortality rate stood at 67 deaths per 1,000 live births in 2018 (Geobase. Gazetter-Niger, 2018). This rate of 67 deaths per 1000 live births is far above the 30 deaths per 1000 live births which is globally accepted in the millennium development goals as at 2015 (Federal Republic of Nigeria, 2010). There are also differences in infant mortality rate between urban and rural areas in Nigeria and even within the six geopolitical zones in the country. Infant mortality rate in rural areas of Nigeria is about 86 deaths per 1000 live births and 60 deaths per 1000 live births in the urban areas (Nigerian Demographic and Health Survey, 2013). Within the six geopolitical zones, North-West has the highest level of infant mortality; 89 deaths per 1000 live births. This is followed by South-East with 82 deaths per 1000 live births, North-East with 77 deaths per 1000 live births, North-Central with 66 deaths per 1000 live births, South –West with 61 deaths per 1000 live births and South-South with 56 deaths per 1000 live births (Nigerian Demographic and Health Survey, 2013). The differences in infant mortality and to align with the infrastructure provisioning; The urban areas tend to have lower infant

mortality because the higher level of social infrastructure the regions with better infrastructure seem to have less deaths. Thus this study seems to empirically examine this analysis.
The high incidence of infant mortality in the country is an indication of the poor quality of life of our people and poor social infrastructure.

Previous studies have reported maternal education as key determinant of infant mortality (Caldwell, 1979, Behuiya& Streatfield, 1991, Boehmer & Wilhamson, 1996 and Adetunji, 1995). Some other studies examined the role of social infrastructure (education and health) expenditures (Ahmed & Hasan, 2016, Bokhari, Gai & Goltret, 2007, Edeme, Emecheta & Omeje, 2017, Rajkumar & Swaroop, 2008). Others pointed to the role of breastfeeding (Adlukha & Suchindran, 1985) and income inequality (Rodgers, 1979). No previous study known to the researchers have examined access to social infrastructure and infant mortality in Nigeria. Thus, this paper tends to fill the gap in previous studies by examining access to social infrastructure and infant mortality in Nigeria.
The rest of the paper is organised as follows:

Theoretical Framework

The Mosley and Chen Framework

Mosley and Chen (1984) based their framework of child survival on the assumption that social-economic factors of child mortality operate via a common set of transitional factors. They categorized proximate determinants of child mortality into five categories, which are maternal factors, environmental quality, nutrient deficiency, injury and personal illness control.

Maternal Factors: This has to do with age parity and birth spacing – each of these factors affect infant mortality indirectly by affecting maternal health.

Environmental Quality: This dwells on hygienic factors such as good drinking water and sanitary conditions. Environmental contamination transmits infectious disease to mothers and children and this has negative consequences on infant mortality.

Nutrient deficiency (calories, protein and micro nutrient deficiency): Nutrient deficiency affect the probability of child survival, it also affects the mothers wellbeing. Deficiencies in nutrient during pregnancy and lactation affect the new born infant negatively and result in poor quality of mother's breast milk which affects the nutrient intake of the infant

Injury: This may be physical, burn and poisoning injury. Injury has profuse effect on infant mortality especially at the early stage of birth if adequate care is not taken.

Personal illness control (immunization, malaria prophylaxis, bed net etc): This illness control encompasses both the traditional and modern preventive measures aim at preventing disease during pregnancy and after child births and the quality of the preventive measure is very vital.

The socio-economic determinant of infant and child mortality is grouped into two household and community level variables (Mosley & Chen, 1984).The individual household level variables comprise of individual fathers' and mothers' skills, health and time. Father and mother skills have implication for child survival and this skill is proxy by the educational attainment of the couple. Maternal education enhances child survival by influencing women decision on care seeking, nutrition status and morbidity. Paternal education defines the household income in most cases and the quality of decision taking. However, the maternal education attainment is the key determinant of child survival. This is a result of the strong tie between mothers and child during pregnancy and breast feeding. Maternal education level influences her choice of husband, health, reproductive health behaviour, nutritional status and child care practices (Mosley & Chen, 1984).

Mother's time is another important factor in child survival, time for food preparation, healthcare, bathing of the child, washing clothes and house cleaning. Part of the mother's time is also dedicated to economic activities, especially income generating activities that enhance child survival through health care. They concluded that mother's time depends on the household economic situation and this help to influence infant mortality through the proximate determinants (Mosley & Chen, 1984).

The next individual level variables in the socioeconomic milieu are traditional norms and attitudes. The key determinant in this group is power relation within the household which have strong affinity to social norms and value system. Mostly in traditional society women are saddled with the responsibility of childcare. This power relation affects fertility and the reproductive choice of the women because she has no control over her body. This heinous traditional practice has a negative influence on child survival. The same is applicable to cultural difference between the society and region (Mosley & Chen, 1984).

Community level factors dwell on ecological setting (climate, soil, rainfall, attitude and seasonality): These variables impinge on child survival especially in the rural setting. They influence income generating activities, use of medical facilities and the time apportion to child care. From the political economy angle (political institution, infrastructure and health service are essential determinants of child survival (Mosley & Chen, 1984).

Gender Stratification Theory

Proponents of gender stratification theory posit that it is necessary to draw a dividing line between measures of women's absolute status (such as female secondary school enrolment rate) and measures of women's relative status (such as ratio of female to male secondary school enrolment rate). The relative status of women, the status women hold in comparison to men, is at the bed rock of gender stratification theory (Mason, 1986, Boehmer & Williamson, 1996). Women status and autonomy can be grouped into four dimensions; (1) women's educational status (educational attainment) (2) women's political status (degree of political participation), (3) women's economic status (degree of involvement informal paid job) and (4) women's autonomy throughout their life cycle (degree of decision making in the family). But in this study we consider only women's education status, the justification for this that education is a component of social infrastructure. Again previous studies (Caldwell, 1979, Adetunji, 1995, etc) have established that women education is a key determinant of infant mortality. Caldwell (1993) pointed out three reasons for the link between women's education status and child survival: (1)

with mother high educational attainment there is tendency for changes in family roles giving mother greater say with respect to childcare (2) A highly educated mother tends to be less fatalistic about her sick child. She is more prone to seek medical treatment and more prone to make use of modern medical facilities (3) A highly educated mother is in a better position to demand the attention of health providers and more likely to ask for explanations as to the cause of the illness and how to prevent it.

Empirical Literature

Alves and Belluzzo (2005) analysed infant mortality trends and differentials in Brazil during a forty year period. They used panel regression and their findings established that increase educational attainment and per capita growth are key determinants of infant mortality.

Opera (2015) in his paper women education: importance for reduced infant/child mortality rate and national development in Nigeria. His finding established that women education is a veritable medium for reducing infant and child mortality in Nigeria.

Ghilguber, Bernhardt, Diderichsen and Bustro (2003) examined inequalities in child mortality in Mozambique: Differentials by parental socio-economic position. Their results showed that limited infrastructure or extreme hardship may hinder more educated women to use their capital to improve the health of their children.

Meroyi (2018) in his paper titled determinants of health investment in Nigeria: A case of infant mortality in Nigeria. The result indicated that per capita income and maternal education have significant impact on infant mortality in Nigeria.

Ayenigbara and Olorunmaye (2012) examined the causes of infant mortality in Akoko South West Local Government Area of Ondo State. Their results indicated frequent pregnancies, age of the expectant mother, poor nutrition; poverty and lack of adequate medical care gave raise to infant mortality in the local government.

Nwafo, Ebiriekwe and Onwuliri (2015) investigated the risk factors associated with infant mortality in Owerri metropolis, Imo State in Nigeria. Their findings established that Human Immunodeficiency Virus (HIV) infection, malnutrition, alcohol consumption, mother's education attainment, previous caesarean section, antenatal and post-natal factors contribute to infant mortality.

Akinlo and Sulola (2018) investigated health care expenditure and infant mortality in sub-Saharan Africa. Their results showed that government health expenditure has positive effect on infant mortality and under-five mortality. The results further showed that per capita gross domestic product, health aid, HIV prevalence and immunization have inverse and significant relationship with infant mortality and under-five mortality.

Anyanwu and Erhijakpor (2007) examined the relationship between health expenditures and health outcomes in Africa. They used a sample of 47 countries in Africa, infant mortality and under-five mortality as proxy for health outcomes. Their results indicated that health expenditures contribute to health outcomes for sub-Saharan Africa. But the reverse is the case for North-Africa where a positive relationship exist between health expenditures and health outcomes because of the prevalence of HIV and ethno-linguistics fractionalization but a higher patient – physician ratio and female literacy has a negative and significant relationship with health outcomes.

Boachire and Ramu (2015) investigated the effect of public health expenditure on health status in Ghana. Their findings established that health expenditure affect infant mortality negatively. Thus, they concluded that health expenditure brought about reduction in infant mortality.

Barenberg, Basu and Soylu (2015) undertook a study, the impact of public health expenditure on infant mortality in India. The results of the study showed that public health expenditure dampens infant mortality. The base line specification indicates that an increase in public health expenditure by one per

cent of state – level GDP result to eight per cent reduction in infant mortality. The study also established that female literacy and degree of urbanization also reduced infant mortality rate.

Issa and Ouattara (2005) examined the effect of private and public health expenditures on infant mortality rates: does the level of development matters? Using panel data of 160 countries, their findings showed that health expenditure has a negative impact on infant mortality rates.

Method of Study

This study covers a period of 38 years from 1980 to 2017. The justification for this period is that it covers both the military and civilian regimes in Nigeria. The data for this study are annual time series data. Augmented Dickey Fuller test (ADF) is used to test for the stationarity of the variables, while the Johansencointegration is used to test the long run relationship and the error correction mechanism estimate the model. The Granger Causality test is used to test for the direction of causality. The data for the study were generated from World Bank, World Health Organization and National Bureau of Statistics several issues.

Model Specification

An eclectic approach involving Gender stratification theory and Mosley and Chen framework is adopted in this study. Gender stratification theory posits that women intellectual inferiority was a product of their inferior education and this was man-made (Felix, 2017). Women subordination was as a result of gender norms, rather than their biological sex (Felix, 2016 and Parpart, Connelly & Barriteau, 2000). Gender stratification theory advocated equal opportunities for both men and women in education and before the law. The relevance of this theory to this study is in its contention that women subordination, lack of access to education, health and poverty are products of gender relations in our patriarch society and these have serious implication for infant mortality: Thus, the social infrastructure and infant mortality equation is stated thus:

IMR = *f [FPE, FSE, FRT, IMZ, NMW, PPR, PCE]* - *4.1*

Where:

IMR	=	Infant mortality rate to capture infant mortality	capture
FPE	=	Female enrolment rate in primary school	access to
FSE	=	Female secondary school enrolment	
FRT	=	Female enrolment rate in tertiary institutions	
IMZ	=	Number of children immunized	capture access
NMW	=	Nurse/midwives	to health
PPR	=	Patient's Physician ratio or doctor density	
PCE	=	Per capita electricity consumption]	control variable

Note: FPE, FSE, FRT, IMZ, NMW, PPR are proxies measuring access to social infrastructure.

Equation 4.1 is transform into an econometric equation to ease of empirical verification.

$IMR = b_0+b_1FPE+b_2FSE+b_3FRT+b_4IMZ+b_5NMW+b_6PPR+b_7PCE+\mu$ -- *4.2*

Result Presentation and Discussion

The results of the data analysed are presented in the following order: The unit root (stationarity test) result, Johansen Cointegration test result, Lag criteria test result, the Granger Causality result and the error correction mechanism result.

Unit Root Test

Table 5.1: Unit Root Test Result

Variables	**Level**	**1st Difference**	**Order of Integration**
IMR	0.298227	-3.865071	1(1)
FPE	-0.611397	-4.487561	1(1)
FRT	-0.589881	-5.977523	1(1)
FSE	0.489047	-6.409444	1(1)
IMZ	-2.584257	-8.102604	1(1)
NMW	-0.0011792	-7.658287	1(1)
PPR	-0.379020	-6.184658	1(1)
PCE	-0.963734	-8.563077	1(1)

Source: Author Computation Using E-View 10.

Note: ADF criterion value at 5 per cent level of significance = -2.945842. The unit root test is at 5 per cent level of significance.

Given the result in table 5.1 above the Augmented Dickey Fuller (ADF) test shows that the entire variables are integrated of order one 1(1). Given that the entire variables are integrated of order, justifies the adoption of the Johansen Cointegration test to test for the existence of cointegration or long-run relationship among the variables.

The Johansen Cointegration Test

Table 5.2: Johansen Cointegration Result

Trend assumption: No deterministic trend
Series: IMR FPE FRT FSE IMZ NMW PCE PPR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.940116	277.8694	143.6691	0.0000
At most 1 *	0.802074	176.5168	111.7805	0.0000
At most 2 *	0.678599	118.2018	83.93712	0.0000
At most 3 *	0.622623	77.33946	60.06141	0.0009
At most 4 *	0.451067	42.25707	40.17493	0.0304
At most 5	0.357920	20.66504	24.27596	0.1335
At most 6	0.119409	4.715501	12.32090	0.6078
At most 7	0.003817	0.137667	4.129906	0.7595

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.940116	101.3526	48.87720	0.0000
At most 1 *	0.802074	58.31503	42.77219	0.0005
At most 2 *	0.678599	40.86232	36.63019	0.0151
At most 3 *	0.622623	35.08239	30.43961	0.0123
At most 4	0.451067	21.59203	24.15921	0.1072
At most 5	0.357920	15.94954	17.79730	0.0928
At most 6	0.119409	4.577834	11.22480	0.5388
At most 7	0.003817	0.137667	4.129906	0.7595

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Johansen Cointegration result shown in table 5.2 above indicates there is long-run relationship among the variables. This is justified by the trace and maximum eigenvalue test statistics that indicate the existence of 5 and 4 cointegrating equations respectively. The next step is to ascertain if there existsgranger causality.

Granger Causality Test

Tables 5.3: Granger Causality Test Result

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
FPE does not Granger Cause IMR	36	2.08299	0.0859
IMR does not Granger Cause FPE		2.80290	0.0760
FRT does not Granger Cause IMR	36	7.13012	0.0028
IMR does not Granger Cause FRT		1.76638	0.1877
FSE does not Granger Cause IMR	36	5.29806	0.0047
IMR does not Granger Cause FSE		2.61364	0.0893

IMZ does not Granger Cause IMR	36	0.10014	0.9050
IMR does not Granger Cause IMZ		0.98356	0.3853
NMW does not Granger Cause IMR	36	5.72593	0.0017
IMR does not Granger Cause NMW		0.64630	0.5309
PCE does not Granger Cause IMR	36	5.83259	0.0071
IMR does not Granger Cause PCE		7.19339	0.0027
PPR does not Granger Cause IMR	36	5.69632	0.0060
IMR does not Granger Cause PPR		7.47068	0.0022

The Granger Causality test result is shown in table 5.3 above. The result shows that there is a unidirectional causality from female access to tertiary institutions to infant mortality. This implies that female access to tertiary institution (FRT) granger cause infant mortality. Female access to secondary education (FSE) also granger causes infant mortality. Availability of Nurses/Midwives (NMW) at place of birth granger cause infant mortality. Patient physician ratio or doctor density granger cause infant mortality. However, it is bidirectional causality. There is also bidirectional causality between the control variable (PCE) and infant mortality.

Error Correction Mechanism Test

Table 5.4: Parsimonious Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.329931	0.793938	-0.415563	0.6822
D(FSE(-1))	-0.455070	0.185887	-2.448103	0.0237
D(FSE(-2))	-0.380832	0.211256	-1.802704	0.0865
D(FRT)	-0.637815	30.61760	1.841364	0.0805
D(FRT(-1))	-1.053975	28.11977	3.219790	0.0043
D(FRT(-2))	-3.390532	22.56876	3.502312	0.0086
D(IMZ(-1))	0.050785	0.059026	0.860377	0.3998
D(IMZ(-2))	0.044877	0.053383	0.840657	0.4105
D(NMW(-1))	-3.178755	14.58543	-2.179404	0.0414

D(NMW(-2))	-8.456420	17.45547	-0.484457	0.6333
D(PCE(-1))	0.052058	0.040678	1.279768	0.2153
D(PCE(-2))	0.031557	0.042036	0.750718	0.4616
D(PPR(-1))	-6.170578	19.35172	-3.188645	0.0046
D(PPR(-2))	-4.486036	16.47313	-2.723244	0.0131
ECM(-1)	-0.405544	0.156204	2.596251	0.0173

R-squared	0.637855	Mean dependent var	-3.112286
Adjusted R-squared	0.474353	S.D. dependent var	2.535313
S.E. of regression	1.989286	Akaike info criterion	4.510956
Sum squared resid	79.14521	Schwarz criterion	5.177534
Log likelihood	-63.94173	Hannan-Quinn criterion.	4.741059
F-statistic	2.516178	Durbin-Watson stat	2.1 04722
Prob(F-statistic)	0.029242		

Table 5.4 reports the final parsimonious result that emanate from the over parameterised result. The result indicates that the error correction term (-0.405544) has the correct sign (negative) and it is significant at 5 per cent level of significance given its probability value of 0.017. The error correction term also shows the speed of adjustment which indicates how the departure from the long-run equilibrium between infant mortality and its determinants are corrected on yearly basis. 41 per cent departure from the long run equilibrium is corrected in one year.The explanatory variables explained about 47 per cent variation in the dependent variable as shown by the coefficient of the adjusted R-squared.

Female secondary school enrolment (FSE) at lag period one has a negative coefficient (-0.45) and it is statistically significant. This implies a percentage increase in female secondary school enrolment will reduce infant mortality by 0.45 per cent. Female tertiary institution enrolment (FRT) at period one and two have negative coefficient (-1.05 and -3.39) and both are statistical significant at 5 per cent level of significance. The implication is that a one per

cent increase in female tertiary institutions enrolment at lag period one will result to 1.05 per cent reduction in infant mortality. A percentage increase also in female tertiary institutions enrolment at lag period two will bring about 3.39 per cent reduction in infant mortality. This shows that education empowers women to take decision that affect them and their children and also provide them with formal job that enable them to pay the user fee charge in hospital. The reason is that women educational attainment helps them to married well to do husband that enhance their financial status. Female primary school enrolment (FPE) is dropped from the final estimated equation, because its coefficient is insignificant in all the experimental runs.

Immunization has positive coefficient but it is not significant. The availability of nurses and midwives (NMW) has a negative coefficient (-3.17) at lag period one and it is statistically significant. This implies that a one per cent increase in the availability of nurses and midwives at place of birth will reduce infant mortality by 3.17 per cent. The reason for this is that nurses and midwives have the requisite skill in child delivery.

Patient-Physician ratio (PPR) has negative coefficient at lag period one and two and there coefficients (-6.17 and -4.48) are statistically significant at 5 per cent level of significance. This buttress that increasing patients-physician ratio by one per cent will reduce infant mortality by 6.17 per cent in lag period one and 4.48 per cent in lag period two. This implies that the availability of medical doctor at the place of birth and after birth will help to reduce the incidence of infant mortality because danger signals can easily be identified and adequate treatment given to avert it.

Per capita electricity consumption (PCE) has positive coefficients at lag period 1 and 2 but it is not significance.

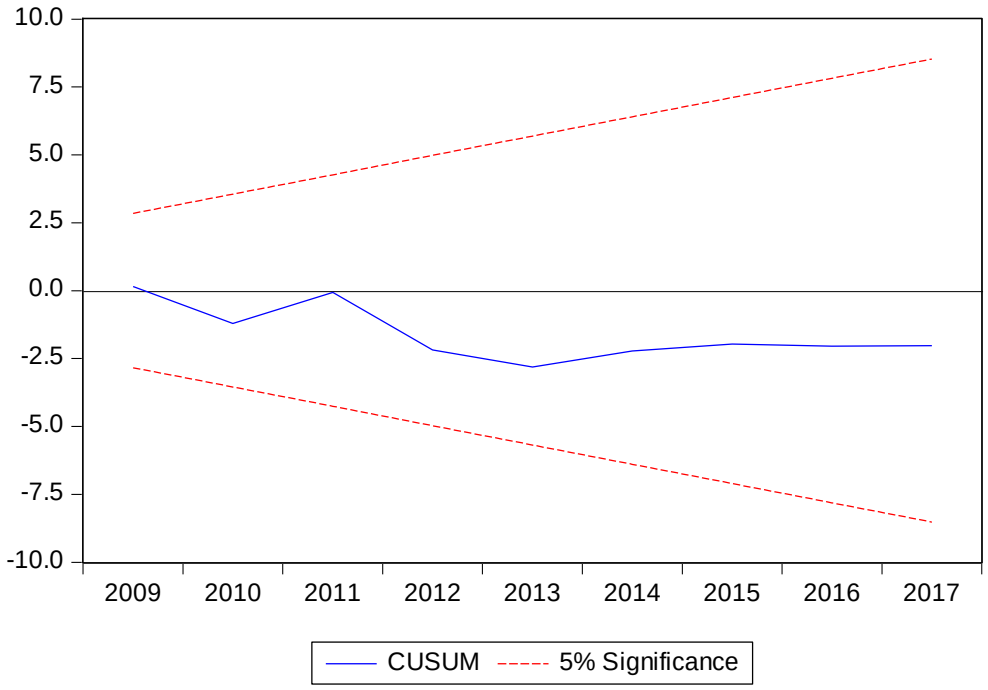
Diagnostic Test

Table 5.5: Diagnostic Test Results

Serial correlation LM test	F(2,18)1.915758	0.6707
Hetroskedasticity	F(14,20) 0.552432	0.8706
Normality test	0.228074	0.892225

The diagnostic test (sensitivity test) results show that the model specified above has the desired econometric properties. There is the absence of serial correlation, the variables are homoscedastic and they are normally distributed.

Stability Test



The stability test is performed using the cusum graph and the result buttress that the model is stable. This is because the graph falls within the two critical bounds.

Conclusion

The objective of this paper is to examine the relationship between social infrastructure and infant mortality in Nigeria. The variables for the study were subjected to econometric analysis and the following inference drawn: social infrastructure (proxy by FSE, FRT, NMW and PPR) is inversely related to infant mortality. Thus access to social infrastructure brings about reduction in infant mortality.

Recommendations

Based on the inference arrived at in this paper, the following recommendations were put forward:

(i) Female education should be encouraged through the award of scholarships.

(ii) Incentives should be given to nurses, midwives and medical doctors as to limit the rate of brain drain in the country.

(iii) Scholarships should be given to medical students and that of allied disciplines.

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