PUBLIC INFRASTRUCTURE EXPENDITURE, GOVERNANCE AND INFANT MORTALITY IN NIGERIA

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Abstract

Government play a crucial role in providing public infrastructure to improve the quality of life her citizenry and to promote sustainable economic growth and development. The objective of this paper is to examine the mediating effect of governance on public infrastructure expenditure – infant mortality nexus, using quarterly series data. The data were sourced from the Central Bank Statistical Bulletin, National Bureau of Statistics and World Bank data bank. The data were subjected to stationarity test using the Philip-Perion (PP) test and the result shows that all the variables were stationary at first difference exception of voice and accountability which is stationary at level. Both Johansen Cointegration and autoregressive distributed lag model techniques were used in analysing the data. The results of the data analysed show that there is a long-run relationship between infant mortality and its determinants. An inverse and significant relationship exist between infant mortality and public infrastructure expenditure, but when governance indicators were introduced it mediates the public infrastructure expenditure – infant mortality nexus by reducing its coefficients. Thus, the paper concludes that governance inhibits improvement in infant mortality via its effect on public infrastructure expenditure. The paper recommends that expenditure on public infrastructure should be increased through the award of scholarship, free antennal and postnatal care and death sentence for corrupt leaders.

Keywords:Control of corruption, governance, infant mortality, political stability, public infrastructure expenditure and voice and accountability.

Introduction

An important socioeconomic aspect of health is that each person is endowed with a minimum amount of health at birth (Grossman, 1972). However, even at birth, health is not equitably distributed among individuals due to differences in the socioeconomic status of parents, particularly the status of mothers, which affect birth weight, an important metric of health status (Rosenzweig and Schultz, 1993). As infants grow through life to become adults, health and its distribution at birth can be changed by policies and by health maintenance activities at the household level. The House of Commons (2009) report notes that each individual is born with a certain amount of 'physiological stock', which fluctuates throughout an individual's life, improving and declining, due to health behaviours and health investments of individuals, families, and governments.

Health is the outcome of consumption of both healthcare and other goods and services (Grossman, 1972). The availability of the consumption of goods and services is determined by economic, social, political, and environmental factors. These goods and services are however provided to populations in limited proportions, especially in low-income countries. This realisation may have informed the declaration of Millennium Development Goals (MDGs), which cover various areas of human capital development. The high incidence of infant mortality rate in sub-Saharan Africa is alarming and about 10 percent of infant mortality in the world in 2017 occurred in Nigeria (Felix & Emma 2018). UNICEF (2017) report documented that five countries account for half of infant mortality in the world in 2017 and Nigeria is third on the list. This could be because of low investment in MDGs related sectors. For instance, there have been concerns about the resources and efforts devoted to the production of health in the country. The per capita expenditure on health has remained far below any world recommended levels in most African countries.

Consequently, the state of health in Africa has deteriorated. The burdens of the disease have not lessened in many African countries. For countries to realize health benefits there have to be purposive

investments in health. This is because of the large benefits of health both as a consumer and as a producer good (Grossman, 1972). Its consumption yields utility and its investment is part of human beings (Schultz, 1961), which enhances the production of goods and services. Health is produced from marketed goods and services like medical care, food, and nutrition, which have a direct influence on health. Government (public) and household (private) expenditures on health both lie in this category because they are direct inputs into the health sector. As expected, government investment in the health sector has a direct impact on the health status of the people. However, this does not mean that the interaction of government expenditure with society-wide variables and household socioeconomic status does not matter for health.

The levels of infant and under-five mortality and prevalence of Hiv/Aids differ, from state to state despite government budgetary allocations designed to promote health and education equity. Government and household health and education expenditures across the states show significant differences. Some get substantially higher budgetary allocations than others. It is however not the case that the regions that get higher allocations have better health indicators. It could be that those with poor health indicators get more budgetary allocations than those with relatively good indicators as the government attempts to influence the production of good health in such states. However, it is yet to be established whether it is the government expenditure and/or private health expenditure that plays a greater role in the production of health in these states.

Again, most empirical studies on the relationship between public infrastructure spending and health outcomes system performance show conflicting results. Some studies indicate that the effect of public infrastructures spending on health status is not significant (Carrin and Politi, 1995) while other studies report lower or positive effect (Gupta. Verhoeven and Tiongson, 2002, Gupta, Verhoeven and Tiongson, 2001); throwing some doubt on the conclusiveness of these studies.

Given the unsettled nature of the nexus between public infrastructure spending-health outcomes, the significance of governance comes to mind. It is a well-known fact that public infrastructure influences health outcomes but, in poorly governed countries, high levels of corruption may lead to circumvention of taxes that could have been used to finance public infrastructure. High levels of corruption may also lead to the diversion of government funds that could have been used for service delivery to the poor (Rajkumar and Swaroop, 2008).

Despite the importance of understanding the causal relationship between governance and broader health outcomes, much of the empirical literature has mostly focused on the narrower question of whether good governance leads to higher levels of income (Sen, 2014).

Conversely, there is scanty literature on the relationship between governance and broader health outcomes such as infant and maternal mortality, life expectancy at birth etc. The exceptions are Kaufmann, Kraay and Mastruzzi (2004), Rajkumaran and Swaroop (2008), Wolf (2007), and Olafsdottir, Reidpath, Porcrell and Allotey (2011) who confirm the role of good governance in engendering sustainable health care delivery performance. In Africa region, however, many of those previous studies on health spending-health outcome nexus do not account for the impact of governance on this relationship (Akinkugbe and Afeikhena, 1996; Anyanwu and Erhijakpor, 2009). To fill the gap, this paper examines the mediating effect of governance on public infrastructure expenditure- infant mortality nexus. Thus, this study seeks to answer the following thought-provoking questions: Does greater public infrastructure expenditure translates to a reduction in infant mortality in the Nigeria context? Has governance any effect on the public infrastructure expenditure-infant mortality nexus in Nigeria? Has governance any effect on infant mortality in Nigeria?

The remaining part of the paper is organised into the following sections: Section 2 provides clarification for some of the key concepts in the paper; section 3 provides the theoretical framework for the study, while section 4 dwell on the empirical literature review. Section 5 dwells on the method of study and section 6 presentations of results and discussion,

while section 7 concludes the paper and section 8 gives the recommendations.

Clarification of key concepts

Governance: There is no generally accepted definition of governance by scholars. World0 Bank (2010c) defines governance as "…the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implement sound policies; and the respect of citizens and the state for the institutions that govern economic and social interactions among them". To evaluate the quality of governance, the World Bank has developed a methodology used to rank countries of the world according to their governance quality. World Bank employs six categories of variables as an input into their evaluation of governance quality: (i) Voice and Accountability; (ii) Political Stability and Absence of Violence; (iii) Government Effectiveness; (iv) Regulatory Quality; (v) Rule of Law; and (vi) Control of Corruption (Kaufmann, Kraay & Mastruzzi 2003; Kaufmann, Kraay & Mastruzzi 2009).Among these categories of variables, political stability and absence of violence, voice and accountability and control of corruption were chosen to capture governance in this research. The justification for the choice of these three selected variables is base on the fact that the other three variables depend on them.

Political Stability and Absence of Violence: Involves the likelihood of governments being overthrown or destabilized, as well as including political violence and terrorism.

Control of corruption: This captures the perceptions of the extent to which public power is exercised for private gain.

Voice and Accountability: This captures perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and free media. These governance indicators range from approximately -2.5 to 2.5.

Infant Mortality rate: This is the number of deaths per 1,000 live births of children under one year of age.

Public Infrastructure expenditure: This refers to government expenditure on education, health, transport and electricity.

Theoretical Literature

Fiscal Illusion Theory

The theory of fiscal illusion originates from the work of Puviani (1903) (as cited in Mourao, 2008) and with additional impetus from Buchanan (1967). The fiscal illusion is about the misperception of fiscal parameters. According to Oates (1985), fiscal illusion implies persistent views and biases about public budgetary decisions in any direction based on imperfect information. Afonso (2014) argues that the benefits of government programmes appear to be remote and unrecognised by citizens, while citizens feel more directly the impact of sources of financing the budget, such as taxes. The essence of the theory is to expose the fact that sometimes the real programme of government is concealed to accommodate unnecessary spending. This theory is relevant to this study because the real benefits of infrastructure spending may not necessarily translate into an improvement in health outcomes in the same expectation because of the element of illusion in the system. Oates (1985) argues that the misconception of fiscal parameters could considerably distort economic and health choices. This study explains the findings based on this theory as an opportunity to show the direction of fiscal illusion in the cost and benefits analysis of government spending on infrastructure towards the ideology of improvement in health.

Empirical Literature Review

Hilaire (2019) examined the interface of governance with public health expenditure and its effects on health outcomes using a panel covering 43 African countries, from 1996 to 2018. He uses cross sectional, fixed effects and Generalized Method of Moments (GMM) estimators. He established that health expenditure per capita and public spending has a significant impact on health outcomes.

Rehman (2019) examined health care expenditure and health outcomes nexus: new evidence from

SAARC-ASEAN region. Using the World Bank data set for 20 years (1995-2014) in 15 countries of the region, a panel data analysis is conducted where relevant fixed and random effect models are estimated to determine the effects of healthcare expenditures on health outcomes. The separate effects of private and public health expenditures were also explored. Total health expenditure, public health expenditure and private health expenditure have a significant effect in reducing infant mortality rate and the extent of the effect of private health expenditure is greater than that of public health expenditure. Private health expenditure also has a significant role in reducing the crude death rate. However, the study has not found any significant effect of health expenditure on life expectancy at birth. Per capita income growth and improved sanitation facilities have also significant positive roles in improving population health in the region.

Boachie, Rama and Polajeve (2018) study re-examined in Ghana the link between government health expenditures and health outcomes to establish whether government intervention in the health sector improves outcomes. The study uses annual data for the period 1980–2014 on Ghana. The ordinary least squares (OLS) and the two-stage least squares (2SLS) estimators are employed for analyses; the regression estimates are then used to conduct cost-effectiveness analysis. The results show that, aside from income, public health expenditure contributed to the improvements in health outcomes in Ghana for the period. We find that, overall, increasing public health expenditure by 10% averts 0.102–4.4 infant and under-five deaths in every 1000 live births while increasing life expectancy at birth by 0.77–47 days in a year. For each health outcome indicator, the effect of income dominates that of public spending. The cost per childhood mortality averted ranged from US$0.20 to US$16, whereas the cost per extra life year gained ranged from US$7 to US$593.33 during the period. Although the health effect of income outweighs that of public health spending, high (and rising) income inequality makes government intervention necessary. In this respect, development policy should consider raising health sector investment inter alia to improve health conditions.

Mhango and Chirwa (2018) assessed the links between public health spending, governance and health outcomes (infant mortality). The role of governance is measured using the Corruption Perception Index. They assess how governance affects the efficacy of public spending in improving health development outcomes. Their analysis shows, empirically, that the differences in the efficacy of public health spending can be largely explained by the quality of governance. Firstly, corruption worsens health outcomes (hence poor health development); secondly, increased health expenditure lowers child mortality rates. However, public health spending worsens health outcomes when there is poor governance. In other words, corruption indeed reduces the effectiveness of public health spending on infant mortality. These findings imply that to improve health care development, there is indeed a need for improvement in the state of governance.

However, the role of governance and the interaction of governance with public health expenditure appear mixed. One explanation is that maybe the public health expenditure and governance indicator may only imperfectly and partially measure the true amount of resources and quality of the institution, respectively these two variables are supposed to reflect.

Ahmad and Hassan (2016) studied the impact of public health expenditure and governance on health outcomes in Malaysia. An Autoregressive Distributed Lag (ARDL) cointegration framework was used by them to analyse the data from 1984 to 2015. The results based on the bounds testing procedure show that a stable, long-run relationship exists between health outcomes and their determinants; namely income level, public health expenditure, corruption and government stability. The results also reveal that public health expenditure and corruption affect long- and short-run health outcomes in Malaysia. The findings are important to the policy makers in making decisions to improve the citizens' quality of life. They suggest the Ministry of Health of Malaysia conduct more consultations with other ministries and other stakeholders in health services to identify the needs and emphasize on the importance of health program

to the society. At the same time, attention should be given to reduce or eliminate the corruption rate as it has adverse effects on the country.

Makuta and Ohare (2015) examined the quality of governance, public spending on health and health status in Sub-Saharan Africa. Their results establish that public spending on health has a statistically significant impact on improving health outcomes. Its direct elasticity for under-five mortality is between -0.09 and -0.11 while its semi-elasticity for life expectancy is between 0.35 and 0.60. Allowing for the indirect effect of public health spending via interaction with the quality of governance, we find that an improvement in quality of governance enhances the overall impact of public health spending. In countries with a higher quality of governance, the overall elasticity of public health spending with respect to under-five mortality is between -0.17 and -0.19 while in countries with a lower quality of governance, it is about -0.09. The corresponding semi elasticity for life expectancy is about 6 in countries with a higher quality of governance and about 3 in countries with lower quality of governance.

Farag, Nandakumar, Wallack, Gaomer, Hudglan and Ebril (2013) examines the relationship between country health spending and selected health outcomes (infant mortality and child mortality), and the role of governance using data from 133 low and middle-income countries for the years 1995, 2000, 2005, and 2006. Health spending has a significant effect on reducing infant and under-5 child mortality with an elasticity of 0.13 to 0.33 for infant mortality and 0.15 to 0.38 for under-5 child mortality in models estimated using fixed- effects methods (depending on models employed). Government health spending also has a significant effect on reducing infant and child mortality and the size of the coefficient depends on the level of good governance achieved by the country, indicating that good governance increases the effectiveness of health spending. This paper contributes to the new evidence pointing to the importance of investing in health care services and the importance of governance in improving health outcomes.

Rajkumar and Swaroop (2007) studied the links between public spending, governance, and health outcomes. They examined the role of governance– measured by the level of corruption and the quality of bureaucracy in determining the efficacy of public spending in improving human development outcomes. Their analysis contributes to our understanding of the relationship between public spending, governance and health outcomes, and helps explain the surprising result that public spending often does not yield the expected improvement in outcomes. They show empirically that the differences in the efficacy of public spending can be largely explained by the quality of governance. Public health spending lowers child mortality rates more in countries with good governance. Similarly, public spending on primary education becomes more effective in increasing primary education attainment in countries with good governance. More generally, public spending has virtually no impact on health and education outcomes in poorly governed countries.

Methodology

Data

The data for this paper were sourced from the National Bureau of Statistics, Central Bank Statistical Bulletin and World Bank data bank. The data for governance started in 1996 and giving the short span of the data, the quarterly series is used so as to increase the data as have a robust result.

Estimation Technique and Model Specification

The study uses the Johansen cointegration and the autoregressive distributed lag model (ARDL) bounds test proposed by Pesaran and Shin (1995) and Pesaran, Shin and Smith (2001) to explore the relationship between public infrastructure expenditure, governance and infant mortality in Nigeria. The merit associated with the autoregressive distributed bound test procedure is that it is applicable regardless of whether the model's regressors are purely I(0), purely I(1) or a mixture of both. Another important merit of the bound test procedure is that estimation is possible even when the explanatory variables are endogenous. The Johansen cointegration technique is used in testing the relationship between public infrastructure expenditure and infant mortality, while the autoregressive distributed lag model is used in testing the mediating effect of governance on public infrastructure-infant mortality nexus.

Model Specifications

We adopted Rajkumar and Swaroop (2008) model specification, but with some modification.

Infant Mortality and Public Infrastructures Model 1

The following equation helps us to capture the effect of public infrastructure expenditure on infant mortality.Thus, the infant public infrastructure equation is stated thus:

INF = f (GDE, GHE, GET, PKT, DOP) ---------- 1

Where:

INF = Infant mortality rate to capture infant mortality
GDE = Government expenditure on education
GHE = Government expenditure on health
GET = Government expenditure on transport
PKT = Out of pocket expenditure on health
DOP= Degree of openness (ratio of export and imports to gross domestic product.

Equation1 above can be transformed into the following econometric form:

INF = $a_0 + a_1 GDE + a_2 GHE + a_3 GET + a_4 PKT + a_5 DOP + \mu$ ---------- 2

Where:

a_0 = Intercept
$a_1 - a_5$ = Parameters to be estimated
u = Error term

Governance, Public Infrastructure and Infant Mortality Model

This equation will help us to capture the mediating effect of governance on public infrastructure expenditure-infant mortality nexus. The equation is stated as follows:

INF = f (GDE, GHE, GET, COC, VOA, PSV, PKT and DOP) ---------- 3

Where:

COC = Control of corruption
VOA = Voice and accountability
PSV = Political stability and absence of violence

} Proxy for Governance Indicators

Equation 3 can be rewritten on the following econometric form:

INF = $a_0 + a_1 GDE + a_2 GHE + a_3 GET + a_4 COC + a_5 VOA + a_6 PSV + a_7 PKT + a_8 DOP + \mu$ ---------- *(3.13)*

Where:

a_0 = Slope/intercept
$a_1 - a_8$ = Parameters to be estimated

Presentation of results and Discussion of Findings

Unit Root Test

This paper adopts the Philip-Peron (PP) test in determining the order of integration of the variables. The result of the unit root test is shown in table 1 below:

Table 1: Unit Root Test Result

	Philip-Peron (PP)		
Variables	**Level**	**1st Difference**	**Order of Integration**
DOP	-2.205591	-5.230953	1(1)
GDE	0.006654	-4.694659	1(1)
GET	-2.229939	-4.373584	1(1)
GHE	-0.305044	-5.207612	1(1)
INF	-1.331065	-8.387178	1(1)
PKT	-2.569971	-5.419271	1(1)
PSV	0.854902	-3.659268	1(1)
VOA	-3.219036	-	1(0)
COC	-2.890217	-6.112447	1(1)

PP critical value at 5% = -2.895109

NB: The unit root test is at 5% level of significance.

The Philip-Peron test result in table 1depicts that all the variables are integrated of order one (first difference 1(1)), except voice and accountability (VOA) that is integrated at order zero 1(0) (at level). Given that all the variables in model specification one are integrated of order one, the Johansen cointegration technique is adopted to test for the long-run relationship.

The Johanson Cointegration for Infant Mortality Model without Governance Indicators

The Johansen cointegration test uses two tests statistic, the trace and the maximum eigenvalue test statistic. Using the trace equation the null hypothesis for trace statistic states that there are at most r number of cointegrating vector and the alternative or research hypothesis states that there are r+1 cointegrating vectors.

Table 2: Johansen-Juselius Cointegration Test Result

Trend assumption: Linear deterministic trend
Series: INF GDE GHE GET PKT DOP
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.519193	190.0803	95.75366	0.0000
At most 1 *	0.374174	127.8356	69.81889	0.0000
At most 2 *	0.315428	87.99750	47.85613	0.0000
At most 3 *	0.287025	55.78583	29.79707	0.0000
At most 4 *	0.165648	27.02954	15.49471	0.0006
At most 5 *	0.127938	11.63608	3.841466	0.0006

Trace test indicates 6 cointegratingeqn(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 *	0.519193	62.24466	40.07757	0.0000
At most 1 *	0.374174	39.83810	33.87687	0.0086
At most 2 *	0.315428	32.21167	27.58434	0.0118
At most 3 *	0.287025	28.75629	21.13162	0.0035
At most 4 *	0.165648	15.39346	14.26460	0.0330
At most 5 *	0.127938	11.63608	3.841466	0.0006

Max-eigenvalue test indicates 6 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

From table 2, both the trace and maximum eigenvalue statistic show the evidence of 6 cointegrating equations at 5 per cent level of significance. This is because both trace and maximum eigenvalue statistic are greater than the critical value at 5 per cent level of significance. Thus, establishing that long-run relationship exist among the variables in the model specification one.

Granger Causality Test for Infant Mortality Model

Table 3: Granger Causality Test Result

Lags: 3

Null Hypothesis:	Obs	F-Statistic	Prob.
GDE does not Granger Cause INF	85	6.15522	0.0023
INF does not Granger Cause GDE		1.42032	0.0764
GHE does not Granger Cause INF	85	5.06761	0.0070
INF does not Granger Cause GHE		9.28689	3.E-05
GET does not Granger Cause INF	85	8.31240	0.0021
INF does not Granger Cause GET		1.17357	0.3253

Table 3 shows the result of the granger causality test among the explanatory variables and the dependent variable. The result shows that the null hypothesis that the explanatory variables do not granger cause infant mortality (INF) can be rejected at 5 per cent significance level (P<0.05). The result shows that government expenditure on education (GDE) granger cause infant mortality (INF). Government expenditure on health (GHE) granger cause infant mortality (INF). Out of pocket expenditure on health (PKT), granger cause infant mortality (INF) in Nigeria.

Parsimonious Test for Infant Mortality Model

Having established the existence of cointegration or long-run relationship using the Johansen cointegration technique, we take a further step to explore the short-run dynamics of the model hypothesized.

Table 4: Parsimonious Result for Infant Mortality Model

Dependent Variable: D(INF)

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.236978	0.026021	-47.53829	0.0000
D(GDE)	0.001077	0.003285	0.327761	0.7440
D(GDE(-1))	-0.002945	0.003295	-2.893671	0.0044
D(GHE)	0.002427	0.002923	0.830541	0.4089
D(GHE(-1))	-0.000380	0.002896	2.131309	0.0059
D(GET)	0.000272	0.006551	0.041532	0.9670
D(GET(-1))	-0.010322	0.006728	-1.534164	0.1293
D(PKT)	-0.012491	0.017583	-2.710389	0.0397
D(PKT(-1))	-0.000646	0.017531	3.036831	0.0007

D(DOP)	-0.006772	0.009102	-0.744079	0.4592
D(DOP(-1))	0.003714	0.009219	0.402881	0.6882
ECM(-1)	-0.613663	0.003307	4.131013	0.0001

R-squared	0.804290	Mean dependent var	-1.241799
Adjusted R-squared	0.686009	S.D. dependent var	0.228990
S.E. of regression	0.218921	Akaike info criterion	5.071427
Sum squared resid	3.546543	Schwarz criterion	4.271040
Log likelihood	15.07136	Hannan-Quinn criter.	6.066400
F-statistic	17.27153	Durbin-Watson stat	2.098577
Prob(F-statistic)	0.000810		

Table 4 reports the final parsimonious estimated equation. The result shows that the coefficient of the error correction term (ECM) is well specified (-0.613603) and it is statistically significant given its probability value of 0.0001, supporting our earlier supposition that infant mortality and its regressors are indeed cointegrated. The error correction term (ECM) depicts the speed adjustment; it also indicates the departure from the long-run equilibrium that is corrected in the short-run. The coefficient of the error correction term (ECM) is -0.613663 which suggest a moderate speed of adjustment. About 61 per cent deviation from the long-run equilibrium relationship which exists between infant mortality (INF) and its determinants are corrected in a quarter.

The explanatory variables explain about 69 per cent of the variation in infant mortality. This is confirmed by the value of the adjusted coefficient of determination adjusted R-square value of 0.686. The remaining 31 per cent is explained by variables not captured in the model specification. The result of the F-statistic shows that the model is well specified. The Watson (DW) statistic of 2.0985 shows the absence of serial correlation.

Government expenditure on education (GDE) has a negative coefficient confirming to economic theory in both level and lag period one. But the lag period one coefficient of GDE (-1) is -0.02945 and it is significant. This implies an inverse relationship exist between government expenditure on education at lag period one and infant mortality (INF) in Nigeria. A percentage increase in government education expenditure will result in 0.02945 declines in infant mortality rate in Nigeria all things being equal.

Government health expenditure (GHE) at lag period one has a negative coefficient -0.00038 and it is statistically significant. This shows that an inverse relationship exists between government health expenditure and infant mortality in Nigeria. A percentage increase in government health expenditure at lag period one will result in 0.00038 decline infant mortality rate in Nigeria all things being equal.

Government expenditure on transport (GET) has a positive coefficient at level but not significant. The same applies to government expenditure on transport at lag period one, but the coefficient in negative -0.013022.

Out pocket expenditure on health (PK) has a negative coefficient (-0.012 and -0.0006) at level and lag period one and it is statistically significant and conforms to economic theory. A percentage increase in out of pocket expenditure at level will result in -0.012 decline in infant mortality. While a percentage in PKT at lag period one will result in 0.0006 decline in infant mortality all things being equal.
Degree of openness (DOP) both at level and lag period one are not significant.

Governance, Public Infrastructure and Infant Mortality Model 2

This model is tested using the autoregressive distributed lag model because the variables in the model are of mixed order 1(0) and 1(1).

Autoregressive Distributed Lag (ARDL) Bounds Test.

The result of the autoregressive distributed lag gest is shown in table 5 below:

Table 5: ARDL Bounds Test Result

Null Hypothesis: No Long-Run Relationship Exist		
Test statistic	Value	K
F – statistic	20.4410	8
Critical Value Bounds		
Significance	1(0)	1(1)
10%	1.85	2.85
5%	2.11	3.15
2.5%	2.33	3.42
1%	2.62	3.77

Source: Author's Computation using E-views 10.0

Table 5 shows the calculated f-statistic (f-statistic = 20.4410), portraying that the null hypothesis of no long-run relationship can be rejected at all critical levels. The reason for this is that the estimated bounds test (F-calculated) is greater than the upper bound critical value of 3.77. This shows that there exists a long-run relationship or cointegration between infant mortality, public infrastructures and governance in Nigeria. Having established that long-run relationship exists among the variables, we dovetail to estimate the long-run coefficients by estimating an ARDL of the order 4,1,1,0,1,0,0,4,1.

Estimation of Long-Run Coefficients of ARDL (4,1,1,0,1,0,0,4,1)

Table 6: Estimated Long-Run Coefficient of ARDL (4,1,1,0,1,0,0,4,1)

Levels Equation

Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDE	-0.481138	0.449043	-2.071472	0.0030
GHE	-0.818165	0.863315	-2.947702	0.0069
GET	-1.270453	1.246850	-2.018929	0.0121
PKT	-13.05123	14.19297	-0.919556	0.3613
DOP	-2.530551	3.352058	-0.754925	0.4531
COC	-5.315969	42.87017	-1.240016	0.2196
PSV	4.141737	45.59330	0.908409	0.3671
VOA	3.153280	40.34432	0.781592	0.4374
C	1.818043	1833.699	0.991462	0.3253

EC = INF - (-0.4811*GDE -0.8182*GHE -1.2705*GET - 13.0512*PKT
-2.5306*DOP -5.31597*COC + 4.14174*PSV + 3.15328*VOA + 1.8180428) R^2= 0.597,

The long run result estimated in table 6 indicates that the overall infant mortality model is well fitted given the F-statistic value of 158.83. The explanatory variables explain about 60 per cent of the variation in infant mortality. The remaining 40 percent is explained by variables not included in the model specification.

An inverse relationship exists between government expenditure on health and infant mortality in Nigeria. This result is inconsonant with

the findings Edeme, Emechata and Omeje (2017) which stated that a negative relationship exists between government health expenditure and infant mortality. The inclusion of governance indicators into the model mediates the effect of government health expenditure on infant mortality in Nigeria. This shows that poor governance inhibits improvement in infant mortality in Nigeria. The coefficient of government health expenditure is higher -0.00038 when the governance indicators were not included in the model. But when the governance indicators were included in the model the coefficient of government health expenditure declined to -0.818, this buttress that poor governance mediates between government health expenditure and infant mortality in Nigeria.

Government expenditure on education has a negative relationship with infant mortality in Nigeria. This result is in line with an economic theory which states that an inverse relationship exists between government education expenditure and infant mortality. The coefficient of government expenditure on education is -0.48, which implies a percentage increase in government expenditure on education will result in 0.48 per cent decline in infant mortality. The better equipped the medical doctors, nurses and midwives are a product of quality education, the reduction in infant mortality. The inclusion of governance indicators in the infant mortality model affected government expenditure on education negatively. The coefficient of government expenditure on education is higher -0.0245 than the coefficient of -0.48 with the inclusion of governance indicators. This buttresses the fact that poor governance affects education expenditure and by extension infant mortality.

Government expenditure on transport has a negative coefficient -1.27, implying that an inverse relationship exists between government expenditure on transport and infant mortality in Nigeria. The inclusion of governance into the infant mortality equation, results in a lower coefficient for government expenditure on transport -1.27 compare to -0.01302. This indicates that poor governance affects negatively government expenditure on transport and infant mortality in Nigeria. Out of pocket expenditure on health has a negative coefficient -1305 but it is not significance. Degree of openness a control variable also has negative coefficient -2.53 but not significant.

Control of corruption (COC) one of the indicators of governance has a positive coefficient of 0.315 and it is significant but does not conform to economic theory. The result shows that a direct relationship exists between control of corruption an indicator of governance and infant mortality in Nigeria. A percentage change in control of corruption will result in 0.315 percentage change in infant mortality in Nigeria. The reason for this may be attributed to the brazen corruption that characterized the country. Corruption in the health sector affects the quality of service rendered and this has implication for infant mortality. Corruption also in the education sector affects the quality of our education, with its attendant consequences on health outcomes.

Political stability and absence of violence have a positive coefficient but not significant. Voice and accountability (VOA) have a positive coefficient of 1.53 and it is statistically significant. This shows that a direct relationship exists between voice and accountability and infant mortality in Nigeria. The reason for this may be attributed to the poor level of voice and accountability. Given the poor level of voice and accountability, mismanagement becomes the order of the day and this has implication for infant mortality in Nigeria.

The Granger representation theory states that when variables are cointegrated, there exists an error correction model (ECM) that shows the short-run dynamics of the cointegrated variables towards their equilibrium values.

Estimating the Error Correction of the ARDL Model

Table 7: Estimated ECM Result of the ARDL Model

ECM Regression

Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	0.333411	0.070767	4.711402	0.0000
D(INF(-2))	0.248073	0.077933	3.183149	0.0023
D(INF(-3))	0.273573	0.064227	4.259495	0.0001
D(GDE)	-0.000387	0.000171	-2.262134	0.0271
D(GHE)	-0.000806	0.000213	3.778062	0.0004
D(PKT)	-0.004968	0.001105	-4.497660	0.0000
D(PSV)	-0.049511	0.011144	-4.442984	0.0000
D(PSV(-1))	0.039273	0.011860	3.311296	0.0015
D(PSV(-2))	0.037021	0.012223	3.028803	0.0036
D(PSV(-3))	0.040553	0.010848	3.738171	0.0004
D(VOA)	0.076782	0.008537	8.994015	0.0000
ECM(-1)*	0.7130390	2.55E-05	15.28551	0.0000

The error correction model result is reported in table 7 above. The error term has the correct sign (a negative coefficient) – 0.713 and it is significant. The error term coefficient of -0.713 shows evidence of speedy adjustment towards the long-run equilibrium (that is about 71 per cent disequilibrium is corrected quarterly by changes in infant mortality). This shows that if there is a shock in the system the long-run equilibrium will return to its steady- state easily. The high coefficient of the error correction term is an indication that it will take a very short time to restore the steady-state relation if the system is distorted.

From the result in table 7, it shows that both the short-run and long-run results yielded the same sign for the variables which signifies consistency in the effects of the explanatory variables on infant mortality in Nigeria.

Discussion of Results

Diagnostic Test

Table 8: Diagnostic Test Result

Serial correlation Lm Test	F(2,61)	1.872829	0.1024
Heteroskedasticity	F (23,60)	1.827275	0.2366
Normality Test	9.525852		0.008541

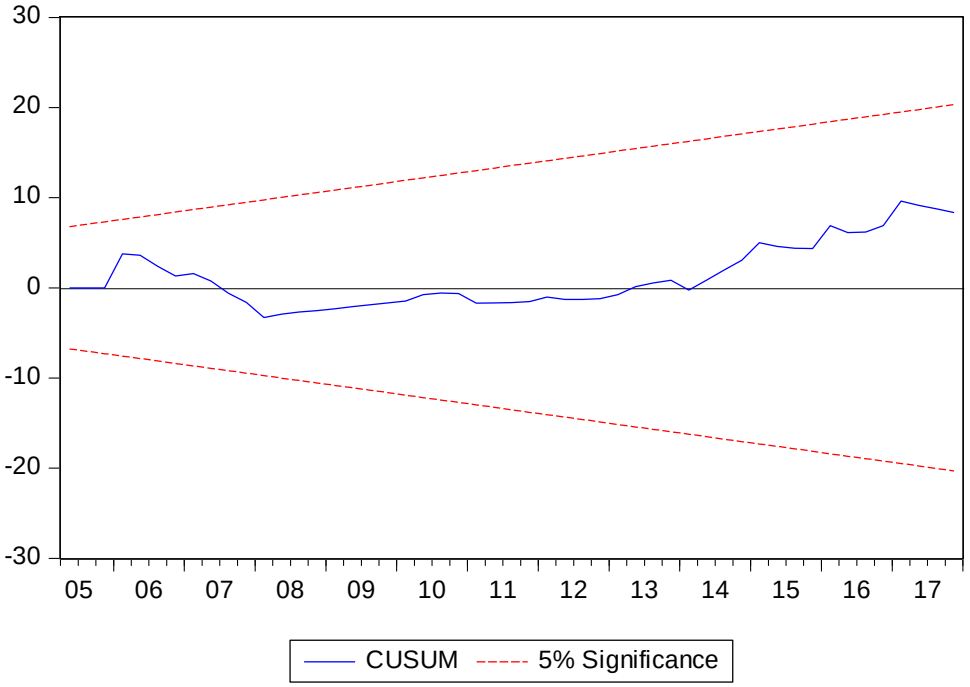
Source: Author's Computation using E-views 10.0

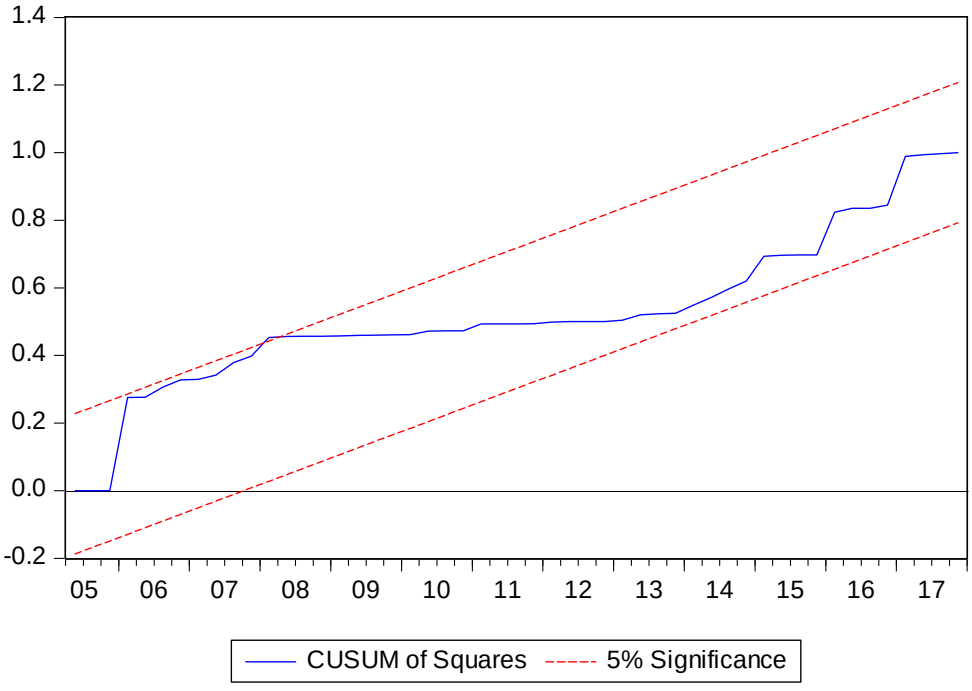
The above empirical estimations for autocorrelation, hecteroskedasticity are used to test the following null hypotheses:

There is no serial or autocorrelation
There is no heteroskedasticity
There is no non-normal error

The result given table 8 shows that the short-run model passed the diagnostic tests. The results indicated that there is no autocorrelation at the 5 per cent level of significance. There is also no heteroskedaticity in the model and that the error term is normally distributed.

Stability Test





In testing the stability of the long-run coefficients with the short-run dynamics, the cumulative sum and cumulative sum squares were used. A graphical illustration of the cumulative sum and cumulative sum square is shown in figure 1 and 2.

As shown in the graphs, the CUSUM and CUSUM squares lines stayed within the 5 per cent critical bound. This proves that the stability of the long-run coefficients of the regressors has an effect on infant mortality in Nigeria.

Conclusions

The paper concludes that an inverse relationship exists between public infrastructure expenditure and infant mortality in Nigeria, while a direct relationship exists between governance and infant mortality in Nigeria. The inclusion of governance indicators in the public infrastructure expenditure-infant mortality model mediates the relationship. Thus governance inhibits improvement in infant mortality in Nigeria via its effect on public infrastructure expenditure.

Recommendations

The paper recommends that the government should increase her expenditure on public infrastructure, through the award of scholarship, free antenatal and postnatal care. Political literacy should be entrenched in both secondary and post-secondary curriculum as to create the desired political awareness and corrupt leaders should be sentenced to death by hanging.

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