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Infant Mortality Rate And Economic Growth In Nigeria: An Empirical Analysis

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ABSTRACT
Infant mortality rate can be mitigated drastically when there is provision for adequate health care for all Infants regardless of the parent's socioeconomic status, particularly in Nigeria where only the rich access good health care. The Novelty of the research is to examine the response of economic growth to the shocks of infant mortality in the context of Nigeria. This study utilized secondary data obtained from the World Bank Development Indicator (WDI) spanning from 1970 to 2022. The unit root test was applied which indicates that all series or variables of interest are integrated into order 1. The multiple linear regression (MLR) model was employed and the results show that infant mortality has a negative significant influence on economic growth which implies that when there is improved economic growth in Nigeria, infant mortality will decline drastically. Similarly, the impulse response function plot reveals that the impulse response is below the zero line threshold which indicates a negative impulse response and this also suggests that the infant mortality rate in Nigeria will decline by an improved or better economic growth. Therefore, the government need to adopt realistic economic policies to improve the national revenue that will secure economic growth and encourage improved budget allocation to the health sector that will enable sustainable health care which gives room for equality in providing adequate health care for all infants in Nigeria which in turn will reduce the cases of infant mortality rate.
Keywords: Infant Mortality Rate, Economic Growth, Unit Root Test, MLR Model, Impulse Response

INTRODUCTION
Is there a correlation between economic growth and improved child health outcomes in developing nations? Although there exists evidence indicating a positive association between economic prosperity and the health status of adults in developed nations (Adams et al., 2003), the presence and causal impact of such a relationship on the health status of infants and young children in developing countries remains uncertain. According to recent empirical findings, there appears to be limited or no significant association

between GDP per capita and early children height-for-age z-scores, specifically in connection to underweight indicators (Vollmer et al., 2014). Aiyar and Cummins (2021) provide a differing viewpoint, contending that there is a discernible but minor impact of growth on height-for-age. This influence is observed to manifest gradually, reaching its zenith at the age of 3, particularly among children from more advantaged backgrounds who exhibit accelerated development.

The presence of a positive correlation between economic growth and health status is subject to challenges related to reverse causality. Improved economic conditions contribute to enhanced health outcomes through factors such as improved access to healthcare, adoption of more nutritious diets, and increased health-related knowledge. It is particularly noteworthy that the socioeconomic status of parents significantly influences the health outcomes of children (Currie, 2009; Almond et al., 2018). However, the improvement of health conditions leads to a rise in the accumulation of human capital, labour productivity, and subsequently, economic consequences (Alderman and Behrman, 2006; Cole and Neumayer, 2006; Mary, 2018). In summary, the correlation between health and growth is a topic of ongoing debate and lacks a definitive consensus. Furthermore, it is worth noting that the majority of assessments rely on aggregated national statistics to measure economic activity levels, such as GDP per capita. However, it is important to recognize that economic growth is a process that occurs at a localized level, resulting in significant regional disparities within countries (Asher et al., 2021).

Nigeria has experienced notable advancements in economic growth in recent years, leading to its classification as a developing and lower-middle-income nation. However, this positive economic trajectory has not been effectively reflected in substantial improvements in health outcomes. Yaqub and Ojapinwa (2012) reported that the World Health Organization (WHO) evaluated the country's overall health performance as 187th out of 191 Member States in the year 2000. This places Nigeria among the group of developing nations characterized by suboptimal health outcomes and the associated challenges.

The health status of Nigeria is significantly subpar, falling below that of many nations in the West African region. Nigeria's health status is characterized by high child and maternal mortality rates, poor life expectancy at birth, and the prevalence of malaria and tuberculosis (Onisanwa, 2014). These challenges persist despite the economic success that has been achieved thus far. The relationship between health conditions and economic growth is often perceived as reciprocal, with gains in health conditions being attributed to economic advancement, and vice versa (Boachi, 2015). There exists a widespread understanding that economic expansion has the potential to significantly contribute to the enhancement of health outcomes. Increased economic growth may also lead to an increase in public revenue, hence enabling greater investment in health infrastructure (Aluko & Adeniyi, 2015). Against this contextual backdrop, we shall analyze the influence of health, seen as an integral facet of human capital, on economic growth by utilizing data about Nigeria. Several studies have been conducted to examine the elements that influence economic growth in Nigeria. However, none of these studies accounted for the relationship between economic growth and the newborn mortality rate, which serves as a proxy for child health. Hence, the present study aims to investigate the response of economic growth to the shocks of infant mortality in the context of Nigeria.

Empirical Review

The relationship between health and economic growth has garnered considerable attention among scholars, mostly due to the substantial impact of human capital development on facilitating economic advancement. The study conducted by Adeniyi and Abiodun (2011) aimed to examine the influence of health expenditure on the economic growth of Nigeria. The researchers employed data about many variables such as life expectancy at birth, fertility rate, as well as capital and recurring expenditures, covering the period from 1985 to 2009. The outcomes of the study indicate that the efficient allocation of resources within the health sector can lead to a substantial and immediate impact on economic growth. Therefore, it is imperative to improve the quality and nature of healthcare services provided.

The study undertaken by Aluko and Adeniyi (2015) aimed to investigate the influence of health on economic growth within the context of Nigeria. The analysis conducted by the researchers involved the

utilization of a vector error correction model (VECM). The research utilized life expectancy rate, total fertility rate, and per capita health spending as indicators to evaluate the relationship between health and economic growth in Nigeria, both in the short and long run. The authors suggest the adoption of responsible spending methods in the Nigerian healthcare sector as a means to enhance the overall effectiveness and efficiency of healthcare services.

Ebeh et al. (2019) employ time series data spanning from 1982 to 2018 to investigate the influence of infant mortality on economic growth in Nigeria. Through the utilization of the autoregressive distributed lag (ARDL) approach, the authors determine that infant mortality has a considerably negative effect on both short-term and long-term economic growth in the country.

Lucian, Straciuc, Maghiar, and Ciprian (2009) undertook a comprehensive examination to explore the established relationship between economic growth and health. The researchers employed existing research findings and applied them to contemporary data to ascertain the potential correlation between the economic development rate in present member countries of the European Union and the growth rates of various diseases. The researchers analyzed to ascertain the applicability of existing economic theories in the regression of different types of variables across European Union member states from 1995 to 2007. The results suggest a significant association between population health and GDP, with the direction of causality between real GDP and economic growth indicating that economic growth influences the rates of illness growth.

The study conducted by Conceicao and Kim (2010) revealed a noteworthy correlation between economic fluctuations and growth. The researchers made a specific observation that eras characterized by an increase in growth rate are associated with improvements in human development, whereas periods characterized by a decrease in growth rate are associated with a deterioration in human development. Nevertheless, it is crucial to acknowledge the presence of heterogeneity within nations regarding their wealth distribution, alongside an uneven disparity between the rates of economic growth and decline.

Bloom et al. (2018) enhance prevailing production function models of economic growth by integrating two further variables, namely work experience and health, which are regarded as fundamental constituents of human capital. The principal finding of their investigation reveals a robust and significant positive correlation between excellent health and total economic productivity. Nevertheless, it is worth noting that there is a slight discrepancy in the average work experience among other countries. This implies that variations in work experience may not have a substantial impact on elucidating the inequalities in economic development rates. Based on the reports provided, the implications of the findings suggest a correlation between the average level of education in a country and its overall productivity. These findings are consistent with the estimates generated from microeconomic research that examine the relationship between individual education and income levels. This suggests that schooling does not seem to have any discernible external outcomes.

The economic growth model put forth by Bloom et al. (2004) elucidates the process of economic expansion using augmenting factor inputs, fostering technological innovation, and facilitating the diffusion of technology. The major conclusion of the investigation is consistent with the authors' theoretical framework and is substantiated by empirical data at the microeconomic scale. The findings of this study indicate a robust and statistically significant correlation between health outcomes and economic growth.

The results suggest that there is a positive correlation between a one-year increase in life expectancy within a certain population and a 4% increase in productivity. The effect size observed in this study is substantial, indicating that it may be justifiable to allocate additional resources towards improving health. This recommendation is solely based on the influence of health on labor productivity, without considering its direct impact on general well-being. This argument provides a rationale for the allocation of resources towards health expenditures to improve human capital. Nevertheless, the performed study cannot distinguish between the effects of different health programs that are aimed at certain segments of the community.

The study conducted by Boachie (2015) revealed a significant impact of health on the economic growth of Ghana, both in the short-term and long-term. The aforementioned conclusion was derived by employing an autoregressive distributed lagged model (ARDL). The life expectancy rate was employed as the health indicator in the augmented growth model, while other factors influencing growth were incorporated as control variables.

Akran (2008) conducted a study that investigates the correlation between several health indicators and the economic growth of Pakistan. To examine this association, the researcher employs the Cointegration, Error Correction, and Granger Causality techniques, utilizing time series data from Pakistan covering the period from 1972 to 2006. A positive link has been seen between per capita GDP and health indices over a prolonged duration. Moreover, empirical evidence has established a causal relationship between health indicators and per capita GDP.

The study conducted by Onisanwa (2014) in Nigeria demonstrated a bidirectional relationship between economic growth and health indicators. The results of his endeavours, both in the immediate and extended periods, demonstrated a positive and significant influence. The proposition entails the allocation of a substantial investment to the health sector to facilitate long-term economic growth in Nigeria. The existing body of research on X-ray studies has provided evidence supporting a positive relationship between improvements in health and economic growth. Therefore, the current investigation is being undertaken to provide an academic contribution to the existing corpus of literature and address the research deficiency in this particular field. The study aims to examine the response of economic growth to the shocks of infant mortality in Nigeria.

DATA AND METHODOLOGY

Data

This study utilized secondary data obtained from the World Bank Development Indicator (WDI) as a dependable source of data collection. The data was accessed through the link data.worldbank.org and covered the time frame from 1970 to 2022. A purposive sampling technique was employed, selecting data points based on availability within the specified period.

Methodology

Based on the empirical review of the related works to this study, the impact of child health indicators have been studied in different capacities but no study has considered the response of economic growth to the shock of infant mortality rate. It is established that good health including the child and adults is subjected to the country's economic growth. The poor health care in Nigeria and other developing countries can also be attributed to low government revenue due to poor foreign direct investment returns and high government expenditure which make it difficult for the governments of developing nations to allocate relatively high budgets to the health sector. The dilapidated health sector facilities and decline in health experienced professional has contributed to the increase in the cases of infant mortality particularly in Nigeria therefore, this research will adopt a quantitate research method to examine the response of the economic growth (proxy by the GDP) to the shocks of the infant mortality rate. The quantitative research methods are descriptive statistics (such as mean and standard deviation) and econometric approaches such as the unit root test, multiple linear regression model (MLR) and the impulse response function (IRF).

The empirical model that establishes the link between the economic growth proxy by GDP and infant mortality rate (IMR) while controlling for the foreign direct investment returns (FDI) can be specified functionally as follows.

Economic growth = f (Infant mortality, Foreign direct investment)…… (1)

Unit root test

Gujarati (2009) emphasizes the significance of doing a unit root test, specifically employing the augmented Dickey-Fuller approach, to ascertain the presence of stationary series. This preliminary step is crucial in econometric modelling as it allows for the identification and rectification of any irregularities that may potentially result in erroneous conclusions. In this study, other economic models were evaluated, including the multiple regression model and the Impulse response function.

Multiple linear regression model (MLR)

The multiple regression model is suitable here because the dependent variable is continuous with more than one independent or predictor variable. The multiple regression model also helps to establish the link between the dependent and more than one independent variable. The ordinary least square assumptions such as Normality, Autocorrelation and Heteroscedasticity were checked and the multicollinearity diagnosis was also carried out to ensure the fitted MLR does not have a misleading P-value and R-square which is the implication of Multicollinearity if present. The CUSUM plot for the regression model stability was also conducted. For the purpose of this study the MLR can be specified as follows.

$GDP_t = \beta_0 + \beta_1 IMR_t + \beta_2 FDI_t + \varphi_t$…… (2)

Where GDP is the dependent variable and a proxy to the economic growth, infant mortality rate (IMR) is the main independent variable while the foreign direct investment returns (FDI) is a control variable. The t is the given period in years, β_0 is the constant term or intercept and β_1 to β_2 are the slopes or the coefficient estimates. The φ is the error term that takes care of all the unaccounted factors in the model.

Impulse response function

This econometric methodology investigates the reaction of a certain endogenous variable to disturbances arising from another endogenous variable. It is crucial to recognize that the impulse response technique treats all variables as endogenous. The 95% confidence interval is visually depicted by the two red lines, whilst the blue line represents the impulse response. A positive reaction is detected when the impulse exceeds the zero line, whereas a negative response is detected when the impulse drops below the zero line.

Table 1: Variable measurement

Variables	Unit of Measurement	Source
GDP	Billion USD	WDI
Infant mortality	Deaths per 1000 Live Births	WDI
FDI	Billion USD	WDI

Source: World Bank

RESULTS AND DISCUSSION

The results of the analysis of the data collected for this study are presented and interpreted in this section.

Table 2: Descriptive statistics

Statistics	GDP	INFANT MORTALITY	FDI
Mean	172.8246	109.5475	2.050135
Median	72.79728	121.4460	0.896641
Maximum	574.1838	154.3990	8.841062
Minimum	9.181770	56.22000	-0.738870
Std. Dev.	174.1581	28.22399	2.420689
Observations	53	53	53

Source: Author's computation using E-Views Software

Table 2 shows that the average Nigeria GDP which is a proxy for economic growth is about 173 Billion USD with a variability of about 174 Billion USD during the period under review. The variation in GDP is higher than the mean value due to the visible fluctuation in Nigeria's economic growth. Table 2 also shows that the average infant mortality rate in Nigeria is about 110 Deaths per 1000 Live Births which is above 10% per 1000 Live births with a variability of about 28 Deaths per 1000 Live Births and the average FDI is about 2 Billion USD with the variability of about 2.4 Billion USD during the period under review. The period under review is from 1970 to 2022.

Table 3: Unit root test

D (FDI)		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.761489	0.0000
Test critical values:	1% level	-3.56543	
	5% level	-2.919952	
	10% level	-2.597905	
D (GDP)		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.154988	0.0001
Test critical values:	1% level	-3.56543	
	5% level	-2.919952	
	10% level	-2.597905	
D (Infant mortality)		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.941967	0.0000
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

Source: Author's computation using E-Views Software

Table 3 shows that all the series or variables of interest such as the GDP, infant mortality rate and foreign direct investment are statistically significant after the first difference which automatically eliminates the unit root that could lead to an erroneous conclusion. Therefore, further econometrics analysis can be performed.

Table 4: Multiple linear regression model estimate

GDP	Coefficient	Std. Error	t-Statistic	Prob.	VIF
C	699.3433	50.81416	13.76277	0.0000	NA
INFANT MORTALITY	-5.039366	0.396817	-12.69948	0.0000	1.704893
FDI	12.45337	4.626679	2.691644	0.0096	1.704893
R-squared	0.878716	Mean dependent var		172.8246	
Adjusted R-squared	0.873865	S.D. dependent var		174.1581	
Prob(F-statistic)	0.000000				

Source: Author's computation using E-Views Software

The fitted multiple linear regression (MLR) model can be written from the table 4 as follow.

GDP = 699.34 – 5.04Infant mortality + 12.45FDI

The MLR model above reveals that for a 1 Death per 1000 Live Births increase in Nigeria's infant mortality rate, the economic growth will decline by about 5 Billion USD and for a one Billion USD rise in foreign direct investment, the economic growth will also rise by about 12 Billion USD.

Table 4 shows that the coefficient of infant mortality has a negative significant influence on the GDP (proxy to economic growth) which means that the higher the economic growth, the lower the cases of infant mortality in Nigeria which opposes the work of Onisanwa (2014) that demonstrated a positive significant influence of health indicators on economic growth while supporting the work of Ebeh et al (2019) that concluded that infant mortality has a negative significant influence on the Nigeria economic growth and the coefficient of the foreign direct investment (FDI) has positive significant impact on the GDP which implies that the higher the foreign direct investment, the higher will be Nigeria economic growth. This is consistent with the work of Bloom et al (2018) who concluded that there is a significant positive relationship between excellent health and total economic productivity (which can also account for FDI).

Meanwhile, the overall regression (Prob (F-statistic) is statistically significant at a 1% level and this implies that there is a significant linear relationship between the infant mortality rate and Nigeria's economic growth while controlling for the foreign direct investment returns. The variance inflation factor (VIF) for all the independent variables is less than 5 which implies that the model does not suffer from the problem of multicollinearity that could lead to misleading P-values and R-squared. It is pertinent to note that in the process of fitting the multiple linear regression, some other control variables like life expectancy were dropped because it caused multicollinearity. The purpose of the few parameters in the model is to ensure that a parsimonious model was achieved in this study.

The value of R-squared of 0.8787 indicates that 87.87% of the variation in Nigeria's economic growth can be explained by the infant mortality rate and the foreign direct investment while the remaining 12.13% can be attributed to the other factors not included in the model. The R-squared is relatively high and the overall regression model is significant which suggests that the multiple linear regression model is a good fit for the data and it is very suitable for the future prediction of Nigeria's economic growth.

The MLR Diagnostic test

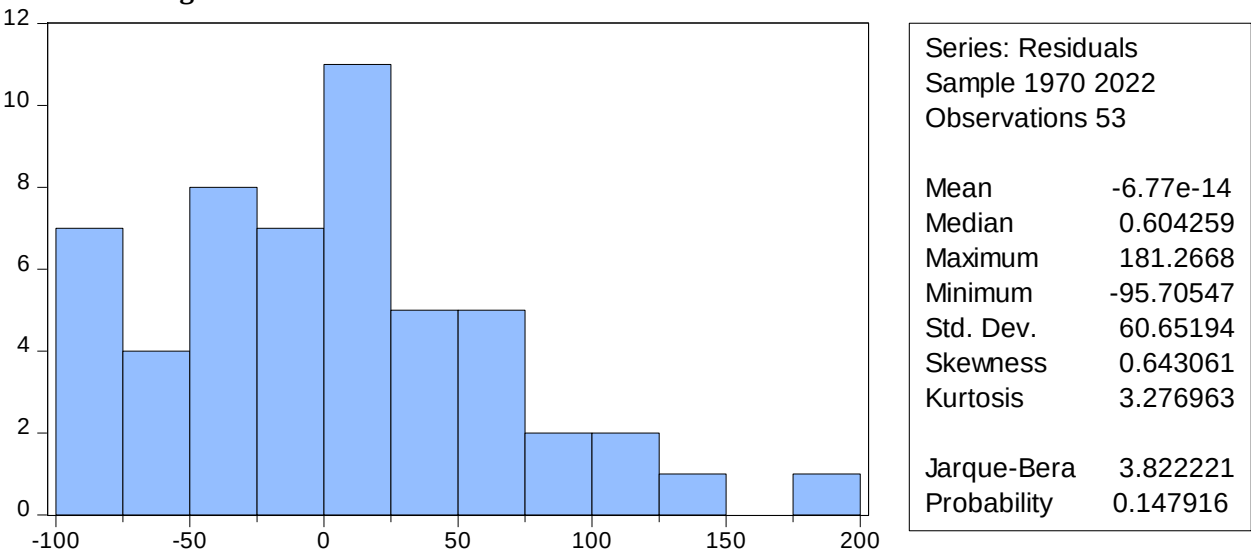

Figure 1: Normality test

Hypothesis for the normality test

Ho: The residual is normally distributed

Ha: The residual is not normally distributed

The Jarque-Bera test for normality in figure 1 shows that the P = 0.1479 is above the 0.05 significant level and this implies that the residual of the fitted MLR model is normally distributed which supports the ordinary least square assumptions of the normality of the residuals.

Table 5: OLS assumption test

Heteroskedasticity Test: Breusch Pagan-Godfrey			
Obs*R-squared	2.138267	Prob. Chi-Square(2)	0.3433
Breusch-Godfrey Serial Correlation LM Test:			
Obs*R-squared	36.32658	Prob. Chi-Square(2)	0.3385

Source: Author's computation using E-Views Software

Table 5 shows that the P-value for both the heteroscedasticity and the serial correlation are above the 0.05 significant level and this implies that the fitted MLR model does not cause the problem of the heteroscedasticity and the serial or autocorrelation respectively. This also satisfies the ordinary least square assumptions.

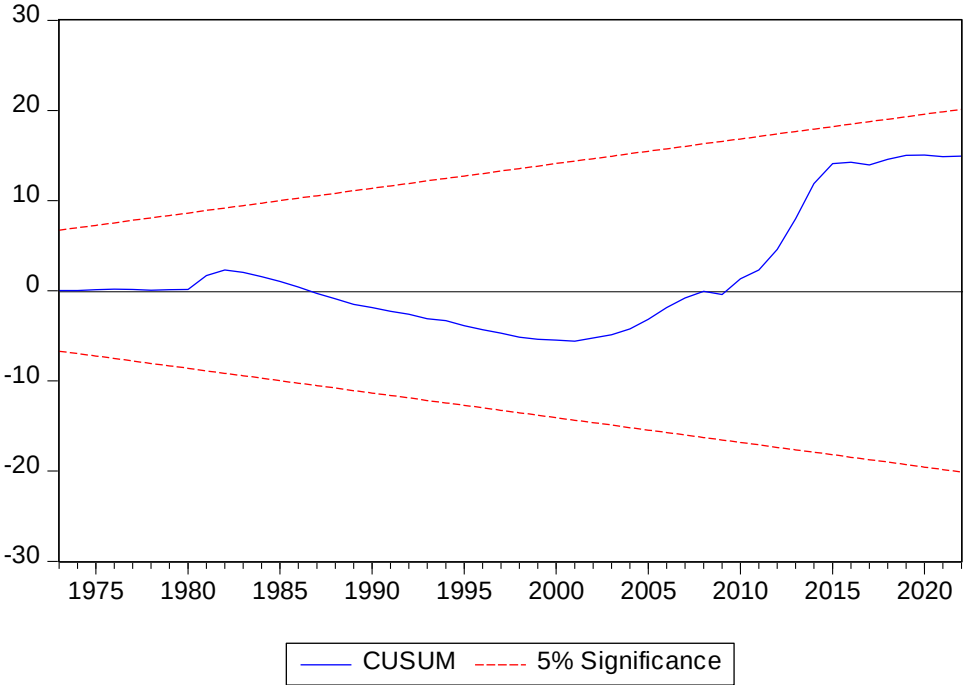

Figure 2: CUSUM Plot for Model Stability

Figure 2 is the CUSUM plot for the fitted MLR model parameter stability which clearly show that the model lies between two 95% confidence interval and this indicate that the MLR model parameters are stable.

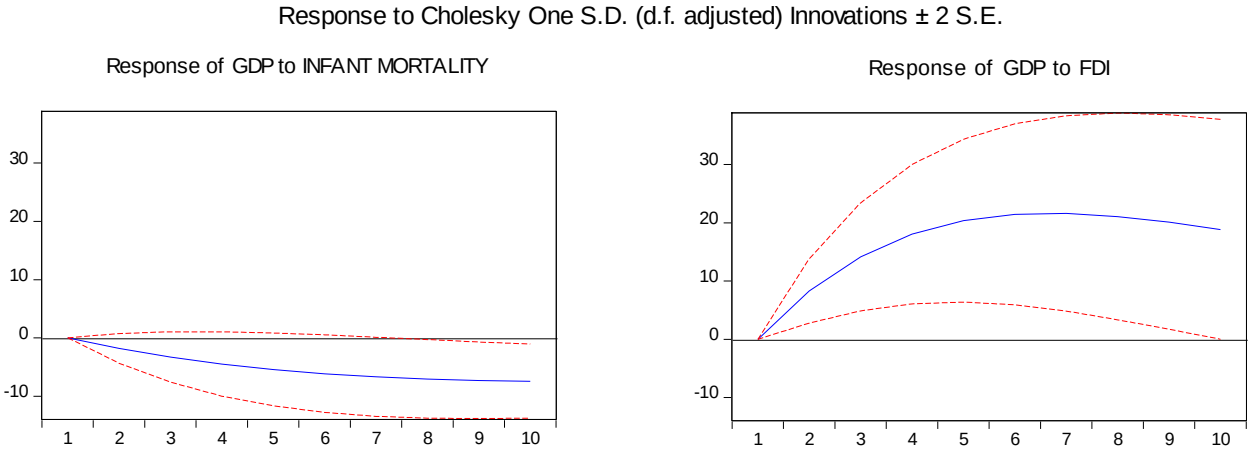

Figure 3: Impulse response function

Figure 3 shows that the impulse response fall between the two 95% confidence interval and the impulse response of GDP to infant mortality fall below the zero line which implies a negative impulse response

which suggests that the higher Nigeria's economic growth, the lower the cases of the infant mortality rate. More so, the impulse response of GDP to FDI is above the zero line which indicates the positive impulse response and this suggests that the higher the foreign direct investment returns, the higher will be the economic growth in the context of Nigeria.

DISCUSSION

The discussion of the key findings deduced from the results of the analysis are discussed in this section.

Health is a crucial domain that demands the attention of every nation. However, the impoverished conditions prevalent in Nigeria and other developing countries hinder certain parents from affording adequate healthcare for their kids, thereby contributing to the issue of infant mortality. This phenomenon may also result in an increase in newborn death rates as a consequence of inadequate funding allocated to healthcare sectors. The COVID-19 pandemic has resulted in a concerning increase in infant mortality rates, mostly due to the limited availability of essential healthcare services for neonates. Hence, it is imperative to analyze the impact of infant mortality shocks on economic growth, which constitutes the original contribution of this research.

Table 3 presents the statistical significance of various series or variables of interest, including GDP, infant mortality rate, and foreign direct investment. It is observed that these variables remain statistically significant even after applying the first difference, which effectively eliminates the presence of a unit root that might potentially lead to inaccurate conclusions. Hence, additional econometric analysis can be conducted.

Table 4 presents empirical evidence indicating that the coefficient of infant mortality exerts a statistically significant negative effect on GDP, serving as a proxy for economic growth. This finding suggests that as economic growth increases, the incidence of infant mortality in Nigeria decreases, contradicting the findings of Onisanwa (2014), who established a positive and significant relationship between health indicators and economic growth. However, it aligns with the conclusions drawn by Ebeh et al. (2019), who determined that infant mortality negatively and significantly impacts Nigeria's economic growth. Additionally, the coefficient of foreign direct investment (FDI) exhibits a positive and statistically significant impact on GDP, implying that higher levels of FDI contribute to increased economic growth in Nigeria. This finding aligns with the research conducted by Bloom et al (2018), which established a notable and positive correlation between optimal health conditions and overall economic output. Furthermore, this association encompasses the potential influence of foreign direct investment (FDI) as well.

In the present study, it is seen that the overall regression exhibits statistical significance. This indicates the presence of a noteworthy linear association between the infant mortality rate and Nigeria's economic growth while accounting for the influence of foreign direct investment returns. The variance inflation factor (VIF) for each of the independent variables is below 5, indicating the absence of multicollinearity in the model. This mitigates the risk of distorted P-values and R-squared values. It is important to acknowledge that during the multiple linear regression analysis, several control variables such as life expectancy were excluded due to the presence of multicollinearity. The primary objective of incorporating a limited number of parameters in the model was to ensure the attainment of a parsimonious model in the present investigation.

The R-squared value of 0.8787 suggests that approximately 87.87% of the observed fluctuations in Nigeria's economic development can be accounted for by the variables of infant mortality rate and foreign direct investment. The remaining 12.13% can be ascribed to additional factors that were not incorporated into the model. The R-squared value has a considerable magnitude, indicating a strong relationship between the predictor variables and the response variable. Additionally, the overall regression model demonstrates statistical significance, implying that the multiple linear regression model adequately captures the underlying patterns in the data. Consequently, this model holds promise for accurately forecasting Nigeria's future economic growth.

Additionally, Figure 2 displays the CUSUM plot illustrating the stability of the parameters of the fitted MLR model. It is evident from the figure 2 that the model falls within the range of two 95% confidence intervals, suggesting that the MLR model parameters exhibit stability. Figure 3 illustrates that the impulse response lies within the range of the two 95% confidence intervals. Additionally, the impulse response of GDP to infant mortality is observed to be below the threshold of zero, indicating a negative impulse response. This finding suggests a potential inverse relationship between Nigeria's economic growth and the incidence of infant mortality, implying that higher economic growth may be associated with lower rates of infant mortality. Furthermore, it is seen that the impulse response of Gross Domestic Product (GDP) to Foreign Direct Investment (FDI) exceeds the threshold of zero, indicating a positive impulse response. This implies that an increase in foreign direct investment yields will result in higher economic growth within the Nigerian environment.

CONCLUSION

The goal of this study is to examine to investigate the response of economic growth to the shocks of infant mortality in the context of Nigeria. The findings of this study indicate a statistically significant negative relationship between infant mortality and GDP in Nigeria. This suggests that as economic growth increases, the incidence of infant mortality decreases. Additionally, the study reveals a statistically significant positive association between foreign direct investment (FDI) and GDP. This implies that higher levels of FDI contribute to increased economic growth in Nigeria. In a similar vein, it can be shown that the impulse response of GDP to the shocks of infant mortality is below the zero line threshold, indicating a negative impulse response. This finding demonstrates that when Nigeria's economic growth increases, there is a corresponding decrease in the incidence of infant mortality. Moreover, it can be shown that the impulse response of Gross Domestic Product (GDP) to the shocks of Foreign Direct Investment (FDI) exceeds the zero line threshold, indicating a positive impulse response. This finding implies that as the returns from foreign direct investment increase, there is a corresponding increase in economic growth within the Nigerian environment.

Therefore, the government should implement pragmatic economic strategies that can effectively attract foreign investments and enhance productivity. This will result in an improvement in national revenue, thereby ensuring economic growth. Additionally, it will facilitate enhanced budget allocation to the health sector, enabling the provision of sustainable healthcare services. This, in turn, will promote equality in the provision of adequate healthcare for all infants in Nigeria, consequently reducing the incidence of infant mortality.

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