

MACROECONOMIC VARIABLES UNCERTAINTY AND HEALTH OUTCOMES IN NIGERIA

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DOI: 10.

Macroeconomic variables uncertainty relationship with key sectors in nations' economies for both emerged and emerging economies have been investigated. In Nigeria, an emerging country, there is dearth of studies that have related macroeconomic variable uncertainty to health system performance. This study thus, bridges the gap by examining the time series of macroeconomic uncertainty and health outcomes by employing the Autoregressive Distributive Lag methodology. The macroeconomic variables investigated in the study are the exchange rate, the inflation rate, per capita income and index of health outcomes. The annual data for these macroeconomic variables span from 1980 to 2019. Augmented Dickey Fuller is employed to ascertain the stationarity state of the engaged macroeconomic data, while cause and effect among the variables are determined using the Granger causality test. In all, the findings reveal that, among the macroeconomic variables, exchange rate uncertainty has substantial impact on health outcomes. Inflation though has significant p-value, its sign is contrary to expectations. While the causality between health outcomes and per capita income is bi-directional, it is one-directional with exchange rate and non-directional with inflation rate. Based on these findings, a key policy recommendation is that, an inward looking approach should be encouraged to seek healthcare inputs within the nation's economy to substitute for the hitherto imported ones. By so doing, foreign currency demand will be greatly eased, and a gradual move towards economic diversification could begin.

Keywords: Macroeconomic variable, Health outcomes, Uncertainty, ARDL, Causality

JEL Classification: A10, E03, I19

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1. Introduction

Macroeconomic variables uncertainties and their implications on economies globally in recent times, have gained wider focus. For instance, studies such as Onyimadu (2016); Ciftci (2014); Onubogu and Dipeolu (2020); Central Bank of Nigeria [CBN] (2015) and many others have one way or the other associated macroeconomic uncertainty with key sectors of nations' economies. However, except Raji (2020) and Oduyemi (2020) [that related the nation's healthcare performance to some known macroeconomic uncertainties]; scholarly investigations on this tropical issue within Nigeria's context have not been too frequent.

A nation's health sector supports its human health (Yaqub, Ojapinwa & Yussuff, 2012). The likely effect on human health is understood using accepted healthcare indicators/health outcomes as measures. Health outcomes thus, are changes in the state of human health as a result of some desirable changes. The importance of health in nations' development cannot be overemphasized. This is because it (health) exerts much influence on the macro-economies of nations (Yaqub et al., 2012). Improved health outcomes (an indication of viable healthcare system) would positively influence the labour force participation rate, human capital formation, productivity and inequality (Darvas, Moës, Pichler & Myachenkova, 2018). This is possibly not the case with Nigeria, going by the abysmal healthcare delivery system revealed by its health indices.

In 2015, the millennium development goals (MDGs) were replaced with sustainable development goals (SDGs), with goal 3 centred on healthy living and on promoting well-being for all by the year 2030. In line with this goal certain targets like reduction in maternal death rate to below 70 per 100, 000 live births, drop in under-5 death rate to 25 per 1000 live births and preventable mortality of new born, were set to be met (Urhie, Afolabi, Afolabi, Matthew, Osabohien & Ewetan, 2020). Less than 10 years to the deadline (2030), Nigeria's health indicators statistics are yet to attaining these set targets. For instance, in 2017, the maternal death was 917 per 100, 000 live births. In 2018, under-5 death was 119.9 per 1000 live births, 36 per 1000 for under-1 and 54.3 years for life expectancy (World Development Indicators [WDI], 2020). Comparatively, while maternal death rate was 7 per 100, 000 same year in the United Kingdom, in 2018, under-5 death rate was 4.3, under-1 death was 2.6 and life expectancy was 81.3 (WDI, 2020). These publicized health statistics for Nigeria suggest that healthy living is still elusive among many Nigerians. Can the appalling healthcare situation therefore, associates with the macroeconomic uncertainties in Nigeria?

Macroeconomics comes to mind when economic uncertainty becomes evident, and macroeconomic uncertainties or macroeconomic variables uncertainties are derivations from macroeconomic variables. They (Macroeconomic variables) are economic policies which are exogenously influenced by government and other factors to achieve set policy targets. Economic policies such as price level (that is, the inflation rate), the exchange rate (ER), per

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capita income and others are centres of initiated macroeconomic policy with the purpose of stabilizing and growing economies of countries (Onyimadu, 2016). In fact, they are candidates for explaining variation in economic activities as changes take place within and outside an economy (Flannery & Protopapadakis cited in Vychytilová, Pavelková, Pham & Urbánek, 2019). Besides being an explanation for changes in economic activities, they show the level of progression of the economic growth/development of countries (Ciftci, 2014).

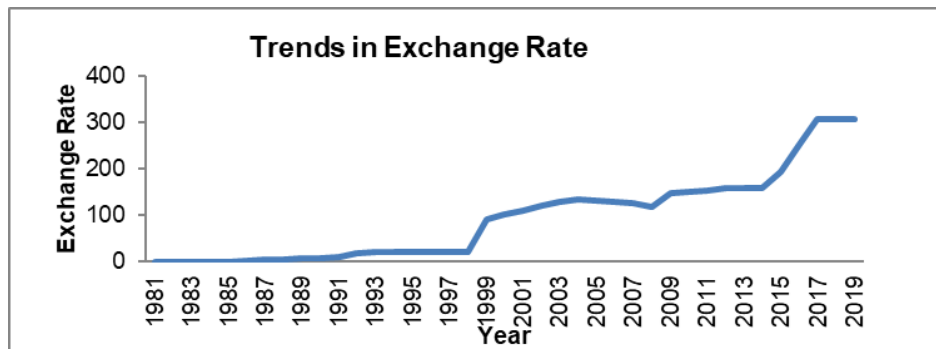
Explaining variation in macroeconomic variables, it is the instability or the ups and downs trend in the macro variables, owing to certain controlled or uncontrolled causative factors. This accordingly, results to uncertainty or variability or instability of macroeconomic variable(s). So, uncertainty being the preferred concept in this context; is undesirable changes that obstruct smooth impact of expected changes, to influence economic agents' decisions making (Montes, 2010). In other words, uncertainty provokes unexpected outcomes. The uncertainty of macroeconomic variables is able to influence all spheres of a country's economic activities (Guney, 2020). A good illustration is that instability in certain macroeconomic variables affect cash flow at both micro and macro levels of most nations' economic activities (Vychytilová, Pavelková, Pham & Urbánek, 2019).

Besides, it has been discovered that uncertainty influences healthcare seeking decision making (Han, Klein & Arora, 2011; Babrow, Kasch & Ford, 1998). Many Nigerians are now seeking inappropriate healthcare service owing to the rising costs of accessing appropriate healthcare service. This (that is, the increasing cost of healthcare services) could come as a result of incoherent implementation of macroeconomic policies in the country. This policy incoherency may have resulted into macroeconomic uncertainty, which could have impacted healthcare delivery to the point of having abysmal health indices in Nigeria. Therefore, to be certain about this probable nexus, this study investigates the likely relationship between macroeconomic uncertainty and health outcomes, with specific intentions to determine the significant effect of the macroeconomic uncertainty on health outcomes and ascertain the causality between these two tropical issues in Nigeria.

Following this introductory section, other sections of the paper is structured as follows: section 2 provides the stylized facts on macroeconomic variables uncertainties and health outcomes in Nigeria. Section 3 is the literature review, which comprises conceptual and empirical literature reviews. In section 4 is methodology, while results and discussion are in section 5. The conclusion and policy implication presented in section 6.

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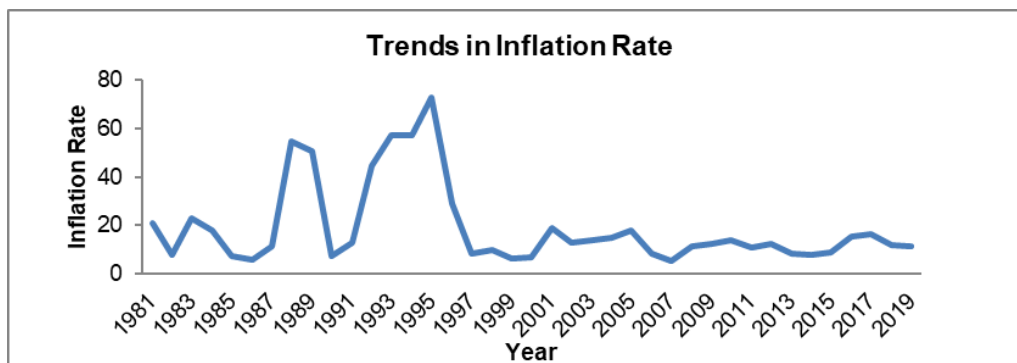
2. Stylized Facts on Trends of Macroeconomic Variables and Index of Health Outcomes in Nigeria



Source: Authors' Computation via E-views 10

Figure 1. Trend of Exchange Rate

Figure 1 shows the graphical representation of the trend of the exchange rate (a macroeconomic variable) in Nigeria between 1981 and 2019. The exchange rate variable is of concern, because of its likely influence on economic activities in the nation's health sector. The exchange rate is the value of a nation's currency versus those of other nations in the world. For instance, in 2019, naira exchange rate to a United State American dollar was ₦307. In 2010, it was approximately ₦150; about ₦102 in 2000; ₦8 in 1990 and ₦0.62 in 1981. A cursory look at this movement shows that since 1991, the unfavourable exchange rate in Nigeria became so evident. The unfavorable gap has since continued and is widening.

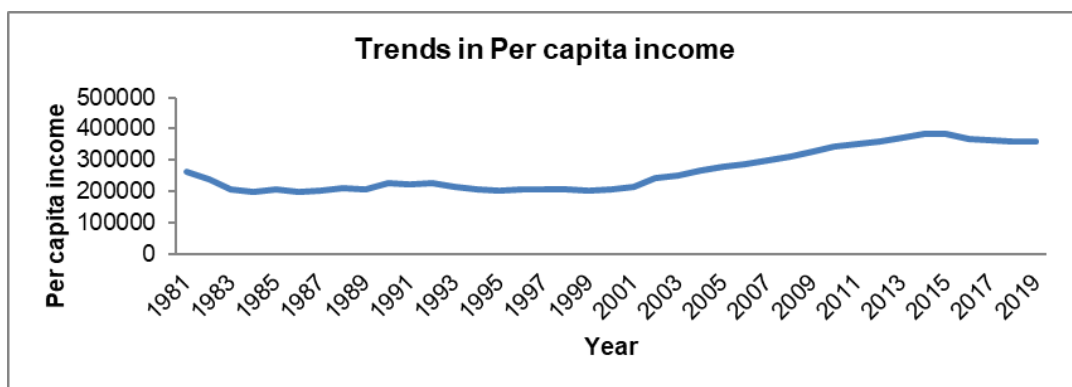


Source: Authors' Computation via E-views 10

Figure 2. Trend of Inflation Rate

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Figure 2 shows the trend of the inflation rate often captures with consumer's price index. In this case, as illustrated in the graph, the movement is somehow oscillatory (that is, ups and downs). The least rate ever recorded during the period under review is 5.39, which was registered in 2007, while the highest is 72.84 in 1995. In 2008, the inflation rate was 11.58, increased marginally all through subsequent years and dropped to 8.06 in 2013. By 2017, it was again as high as 16.52 before plummeting to 11.40 in 2019. This unsteady movement in consumer's price index in Nigeria, exhibits uncertainty in the rate of inflation. Aside 2006, 2007, 2013, 2014 and 2015, inflation rate has been double digits since 2001 till 2019. This uncertainty in inflation rate could have adversely influenced health outcomes via the rising cost of health services.

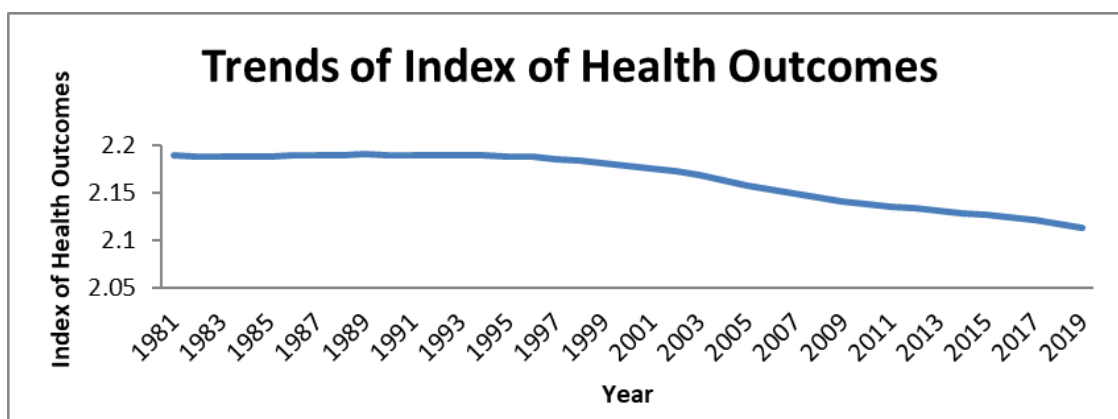


Source: Authors' Computation via E-views 10

Figure 3. Trend of Per Capita Income

The trend of per capita income (PCI) between 1981 and 2019 is as shown in figure 3. PCI is supposed income per individual in a country giving the gross domestic product (GDP) and the yearly population statistics. The PCI plummeted from ₦261, 776.3 in 1981 to ₦199, 039.2 in 1984 (the least amongst the years been considered). It thus rose with some instability in the successive years till it was ₦227, 287.9 in 1992. Thereafter, it fell to ₦203, 050.2 in 1999. It again rose steadily in the succeeding years to a climax of ₦385, 349.0 in 2014 (the highest in the years under review). The PCI somehow in 2015 marginally dipped to ₦385, 236.1, and continues the fall sharply till it was ₦358, 742.1 in 2019. The growth in PCI between 1999 and 2014 was a steady rise, and is the best ever experienced. Aside those years, the trend of PCI in Nigeria has been unstable.

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Source: Authors' Computation via E-views 10

Figure 4. Trend of Index for Health Outcomes

The trend of index for health outcomes (HOC) between 1981 and 2019 is as displayed in figure 4. HOC is a combination of three (3) known common health indicators (life expectancy, infant mortality and maternal mortality rates) manipulated using Kaufmann, Kraay and Matruzzi (2010) analysis of index creation. Looking at the graph, between 1981 and 1996, there seems stability in healthcare system performance, with noticed ups and downs not too evident. However, in the graph, between 1997 and 2003, the HOC witnessed a decrease. This signifies a plummeted health sector performance. Thereafter, the graph shows a gradual drop of the index for HOC till 2019. The trend of the HOC graph between 2003 and 2019 reveals an abysmal healthcare performance. This indeed shows either the reality or a true picture of Nigeria's healthcare delivery system.

To sum up, in line with the nature of the macro variables graphs depicted in figures 1, 2 and 3, they reveal unpredictable or unsteady meandering trends. These irregular movements of the macroeconomic variables are akin to uncertainty. Uncertainties in the macroeconomic variables are likely to influence any country's economy, vis-a-vis activities in the health sector. This thus, motivates the need to investigate the probable effects of macroeconomic uncertainties on Nigeria's healthcare sector. Outcomes from the study shall no doubt shape policy makers' understanding towards enduring healthcare system planning.

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3. Literature review

As mentioned abinitio, this section is structured into three sub-sections (conceptual, theoretical, and empirical literature reviews). In each sub-section, opinions, observations, submissions, and findings of related studies are assessed.

3.1 Conceptual Reviews

Uncertainty (that is, of macro variables) and health outcomes are two key concepts indicated/comprised in the title of the study. Thus, uncertainty and health outcomes are the research variables in focus. Health outcomes had previously been defined as variation in human health status owing to some desirable changes. In other words, certain societal fundamentals influence people states of health to the point of either good or poor. Health outcomes summarily reveal the performance of any nation's healthcare system giving the health status of the people considering major health indicators. There is thus uniformity between health outcomes and health status. Little wonder Yaqub et al., (2012) used the two terms interchangeably. The state of any nation's population health is known via its health outcomes; which are ascertained using three basic health indices such as life expectancy, infant mortality and maternal mortality (Osakede, 2020). Thus, health outcomes reveal the impact of healthcare service delivery on the population health supposedly sick at a point in time, and it is assessed using the known healthcare performance indicators like life expectancy, infant and under-5 mortality rate, maternal mortality rate, etc.

Having understood the concept of 'health outcomes,' it is thus imperative to equally conceptually discuss 'uncertainty' in line with the scholars' submissions. Uncertainty according to Han, Klein and Arora (2011) is pervasive and a challenge which had crept into the healthcare system. These noticed challenges in the healthcare system are long-time, and had prompted documented investigations (Han et al., 2011). Uncertainty according to "Merriam-Webster" dictionary is a state of being uncertain. It also can be associated with words or phrases such as unreliable, variable, fitful, not constant or not certain to occur. In other words, uncertainty is synonymous with words or phrases that denote inconsistency. In the economic analysis of uncertainty, three forms of are recognised. These are methodological, structural and parameter (Silva, Silva & Pereira, 2017). In the submission of Montes (2010), uncertainty impacts the decision making process, and negatively influences economic policies. No wonder it was tagged as 'a pervasive occurrence which adversely affects the healthcare system'.

In some studies, uncertainty has been investigated using different terminologies such as shocks, variability and volatility (Raulatu, Ugben, Augustine & Paul, 2019; Vychytilova et al., 2019; Attari & Safdar, 2013). According to Raulatu et al., shocks which often are external, caused instability in economies, and variability is variance in macroeconomic variables. This has resulted into a debilitating effect on nations' economies. Corroborating this, Bamanga et

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al., (2016) submit that uncertainty detrimentally impacts macroeconomic variables in any economic system.

3.2 Empirical Review

Empirical literature review is essential for the comparison of findings to prevent re-inventing the wheel, and to identify gap(s) in knowledge which requires understanding. Using time-series data which range from 1986 to 2017 and applying the fully modified ordinary least square (FMOLS) method of analysis, Raji (2020) examined macroeconomic conditions on infant and under-5 death rates in Nigeria. Engaging macroeconomic variables like unemployment, exchange and inflation rates, the findings indicated that the unfriendly (that is, unstable) macroeconomic variables worsen both infant and under-5 death rates during the period considered. Though, the result of the study was very instructive, but the health outcomes measurement was not all encompassing. Vital health indicators such as life expectancy and maternal mortality rate were left out. Oduyemi (2020) conducted a study which connected oil price volatility to health outcomes in Nigeria. Applying the vector autoregressive (VAR) methodology to estimate the macroeconomic time-series data which ranged from 1980 – 2017, the outcome revealed that oil price fluctuation is not inimical to health outcomes. The gap covered by the study was indeed vital, as Nigeria is an oil producing nation. However, like Raji (2020), the measurement of health outcomes was equally not all encompassing. This is a key shortcoming in the study.

Engaging secondary data that spans 1990 – 2016 and assessing it using the fully modified ordinary least square (FMOLS) framework, Olaitan, David and Elizabeth (2020) examined the effect of the monetary policy of the Central Bank of Nigeria (CBN) on health and economic growth. Using variables like health index, prime lending rate, gross domestic product (GDP), money supply, interest rate, exchange rate, consumer price index and others, the result showed the mixed macroeconomic variables' effect on health and economic growth in Nigeria. Despite the instructive findings of the study, it failed to reveal the healthcare performance measurement indicator used. This is indeed a major flaw in the study.

Abbuy (2018) carried out an investigation that focused on the influence of the macroeconomic variables on infant death in the West African Economic and Monetary Union (WAEMU) nations between 1980 and 2016. Employing fixed effects instrumental variables estimator in panel data model, the findings revealed that GDP per capita and public health expenditure had significant and asymmetric association with health outcomes proxied by infant death rate. Female literacy and urbanization were equally significant. But they impact the health outcomes variable (infant mortality rate) negatively. The study is indeed fundamental to healthcare policy makers in the region. Health outcomes variable is however devoid of vital known health indices. In what seems a related study but conducted in different climate, Ang, Cruz, Pural and Rosete (2017) studied economic variables impact on child death rate in Philippine. The results showed that the association between food price inflation and

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child death rate was insignificant. However, out-of-pocket spending and government spending links to child death rate (that is, health outcomes) were found to be significant in Philippine. Part of the results somehow supports the findings of Abbuy's study.

Linking uncertainty to other key sectors, Raulatu et al., (2019) in a study which examining effect of global economic policy uncertainties on Nigeria's export earnings, engaged data that span from 1997 to 2016. Having applied ARDL and generalised autoregressive conditional heteroscedasticity (GARCH) methodologies, summary of findings reveals adverse global economic policy impact on export earnings in Nigeria. Thus, Raulatu et al study's findings support Bamanga et al's submission that, uncertainty indeed detrimentally affects nations' economies. However, Raulatu et al's perspective of uncertainty effect focused on global economic policy. This finding is likely not going to be the same as macroeconomic variables uncertainty.

Modeling the impact of macroeconomic uncertainty on monetary policy in Nigeria, the study of Mordi et al., (2015) had a two-fold focus. First, it focused on understanding the degree of monetary policy shocks given the nature of uncertainty, and secondly, on acknowledging the effectiveness of monetary policy influence based on the prevailing degree of economic uncertainty. The GARCH technique was applied on the quarterly data which span 2000:1 to 2015:1 (using macroeconomic variables such as inflation, real GDP growth; real M2 growth; oil price; growth in market capitalization, change in exchange rate and money market activities). In total, the findings showed that macroeconomic uncertainty does not meaningfully weaken monetary policy effectiveness in Nigeria. In other words, the outcomes of the study of Mordi et al reveal 'monetary policy effectiveness macroeconomic uncertainty invariant.'

Still on macroeconomic variables uncertainty, Bamanga et al., (2016) investigated inflation and inflation uncertainty in Nigeria. Testing Friedman's hypothesis if an increase in the average rate of inflation would trigger uncertainty in future rates of inflation, the study utilized monthly data which started from 1960:1 to 2014:07. Employing various econometric methods of analysis such as GARCH, exponential generalised autoregressive conditional heteroscedasticity (EGARCH) and autoregressive integrated moving average ARIMA to evaluate the inflation data, the study's result validated Friedman's hypothesis. That is, uncertainty in any future rate of inflation is occasioned by the rise in the average rate of inflation registered in the preceding years. This finding was expected. It is so because, the trend of ups and downs or the unpredicted meandering of any macroeconomic variable amounts to the uncertainty of that variable.

Examining the sectorial impact of macroeconomic variables uncertainties, Guney (2020) conducted a study of macroeconomic uncertainty and investment in Turkey. The essence of the study was to ascertain factors that drive private investment in Turkey. Thus, the focus of the study was on the relationship between macroeconomic uncertainty and private

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investment. The study applied the GARCH approach to quarterly data of macroeconomic variables such as exchange rate, inflation, growth, United State Dollar/Turkey exchange rate and Europe/Turkey exchange rate which span 1994:1 to 2018:1. Adopting the ARDL framework to estimate the data, the findings showed that, in the short-run uncertainty significantly adversely affect investment. But, in the long-run, inflation, exchange rate and growth uncertainties negatively affect private investment in Turkey.

Attari and Safdar (2013) in their study “relationship between macroeconomic volatility and the stock market volatility: empirical evidence from Pakistan” focused on analyzing the influence of the macroeconomic uncertainty on stock market in Pakistan. Using monthly data which span December 1991 to August 2012 from variables such as inflation, interest rate, gross domestic product (GDP) and Karachi Stock Exchange (KST-100 index), EGARCH and granger causality test were deployed to evaluate the data. The results therefore, revealed that macroeconomic uncertainty greatly influences stock market price. Stock price in turn impacts the country’s economy.

In a similar study, but varied in focus, to the research of Attari and Safdar, Vychytilova et al., (2019) focused on the relationship between the volatility of car manufacturers’ stock prices and the effect of macroeconomic variables. Exploring which macroeconomic variable influences car manufacturers’ stock prices; quarterly panel data of 39 car manufacturers quoted on the stock exchange which range from January 2000 to December 2017 in 11 countries were engaged. Applying the genetic algorithm (GA) technique of analysis, the result showed a positive relationship between stock prices of car manufacturers’ uncertainty and macroeconomic variables like stock market development, GDP and unemployment. It was, however, negatively related to the money supply and to the industry production index (IPI).

Ciftci (2014) published a thesis called ‘The influence of macroeconomic variables on stock performance.’ The key objective of the study was to determine the influence of macroeconomic variables on stock performance of various industries. The study’s explanatory variables were crude oil, interest rate; exchange rate and gold, with their monthly data which range January 1997 to September 2014 were analyzed using ordinary least square. Thus, the outcome revealed the effect of varied macroeconomic variables on the industrial stock performances. For instance, crude oil negatively influences stock performance of consumer goods industries, consumers’ services companies, financial and healthcare organizations. However, for oil and gas companies, crude oil had positive impact. The exchange rate had heterogeneous effect, with the interest rate having a zero influence.

Onyimadu (2016) focused on the link between macroeconomic uncertainty and economic growth in 40 African nations. The study used annual data of 5 macroeconomic variables such as real per capita; growth of real per capita GDP; financial development; trade openness and government size which ranged from 1980 to 2014. Employing panel regression with fixed effect to estimate the model, the results contradict the negative relationship between

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volatility and long-run economic growth earlier reported. Instead, the study found a meaningful positive link between volatility and the long-run economic growth.

Having conceptually appraised the two major concepts (uncertainty and health outcomes), and having empirically reviewed the related studies, it becomes evident that in Nigeria, there is a paucity of studies which have investigated macroeconomic uncertainty effect on health outcomes using extended health performance indicators. Considering the policy relevance of macroeconomic uncertainty and its likely impact on the economies of nations, the nature of its relationship with the nations' health sector requires an in-depth understanding. This study thus bridged this gap in order to make meaningful contribution(s) towards uncertainty implications for health outcomes in Nigeria.

3.3 Theoretical Framework

The theory of rational expectations was put forward by John F. Muth in the '60s. Rational expectation was coined to mean a situation whereby outcomes or results are dependent partly on what economic agents (individuals or households) expect to happen owing to changes in some factors. It is a case of positive economics. For example, the price of bread is partly dependent on its demand, and on the expectation of rise in dollar exchange rate to a nation's currency. Rational expectations according to Sargent (2010) are associated with the works of J. M. Keynes, A. C. Pigou and others. That, J. M. Keynes in his work referred to it (rational expectations) as 'wave of optimism and pessimism' which assists to ascertain the degree of any nation's economic activity.

So, Sargent posits that rational expectations are building blocks for the "random walk" or the "efficient markets" theory, the hyperinflation dynamics theory and others. Considering the random walk principle, as pointed out by Sargent, the efficient market theory of stock price uses the rational expectations hypothesis to reach a conclusion according to which changes in stock prices follow a pattern similar to 'random walk.' Random walk according to Lo and MacKinley (2011) is unpredictable meanderings akin to drunkard unsteady movement. By implication, 'random walk' is a movement of ups and downs in a disordered manner. This unregulated changes or movements are prompted by some factors, which in turn are likely to impact economic activities positively or otherwise. Thus, random walk is analogous to uncertainty, and is the unpredicted meandering of some macroeconomic variables that could possibly reshape socioeconomic activities in many economies. Thus, if the rational expectation theory has been described as building block for 'random walk', it can as well be suitable to underpin any investigation associated with uncertainty.

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4. Methodology

In this section, the model to show the relationship between macroeconomic uncertainty and health outcomes is specified (macroeconomic uncertainty – health outcomes). Equally to be discussed would be the adopted techniques for analysis.

4.1 Data and Model Specification

Annualized macroeconomic time-series data sourced from the Central Bank of Nigeria (CBN) Statistical and the World Development Indicators Databases, which, range from 1980 to 2019 are used. Besides the index for health outcomes (HOC) captured by averaging threesome healthcare indices (life expectancy, maternal mortality and infant mortality rates) which are in-line with the methodology of Kaufmann et al., (2010) others are the exchange rate uncertainty (EXR_UNC); the inflation rate uncertainty (INFR_UNC) and per capita income uncertainty (PCI_UNC) which are the variables in focus. Uncertainty in this study is taking to be the unsteady movement of engaged macro variables, using their yearly statistics in series. This aligns with the notion of rational expectation theory of Sargent (2010).

Therefore, to engage the collected data in-line with the stated macroeconomic variables, the study assumes a functional econometric equation of the variables as follows:

$$Hoc_t = f(X_{unc})_t + u_t \quad (1)$$

Where, Hoc_t is the dependent variable and $(X_{unc})_t$ is a vector of uncertainty for the engaged macroeconomic variables, which according to the reviewed studies are likely to have an impact on health outcomes. The purpose of including these variables as suggested by the literature is to avoid spurious findings. Replacing the vector variable with the required explanatory macroeconomic variables, we have an empirical functional model to be analyzed thus:

$$Hoc_t = \beta_0 + \beta_1 EXR_UNC_t + \beta_2 INFR_UNC_t + \beta_3 LnPCI_UNC_t + u_t \quad (2)$$

Where, $LnPCI_UNC_t$ is the natural logarithm of per capita income uncertainty, t stands for period (1980 to 2019) and β is the coefficient, and it reveals the a priori expectations of the various coefficients. Thus, expectedly, β_1 and β_2 are individually less than zero, while β_3 shall be greater than zero.

The autoregressive distributed lag (ARDL) model is therefore adopted in the study, to evaluate the long and short run relationships between the emphasized variables as stated in equation

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(2). ADRL is generally considered appropriate when the results from variables stationarity test show a mixed order of integration [I (0) and I (1)], or a combination of both (Pesaran and Shin, 1999; Pesaran et al., 2001). Aligning with best practices, the Bounds test approach is employed to ascertain for the cointegration nexus among the nation's macroeconomic variables employed. The following ARDL model is used to test the cointegration relationship between the nation's health outcomes and uncertainties in exchange rate, inflation rate and per capita income.

$$\Delta Hoc_t = c_0 + \alpha_1 Hoc_{t-1} + \alpha_2 Exr_unc_{t-1} + \alpha_3 Infr_unc_{t-1} + \alpha_4 lnPci_unc_{t-1} \sum_{i=1}^p \phi_i \Delta Hoc_{t-1} + \sum_{j=0}^{p^2} \phi_j \Delta Exr_unc_{i=j} + \sum_{j=0}^{p^3} \phi_j \Delta Infr_unc_{t-1} + \sum_{j=0}^{p^4} \phi_j \Delta lnPci_unc_{t-1} + u_t \quad (3)$$

Where α_i represents long run parameters, c_0 is the intercept and u_t is error term. The short run dynamic error correction version is as specified below:

$$\Delta Hoc_t = c_0 + \alpha_1 Hoc_{t-1} + \alpha_2 Exr_unc_{t-1} + \alpha_3 Infr_unc_{t-1} + \alpha_4 lnPci_unc_{t-1} \sum_{i=1}^p \phi_i \Delta Hoc_{t-1} + \sum_{j=0}^{p^2} \phi_j \Delta Exr_unc_{i=j} + \sum_{j=0}^{p^3} \phi_j \Delta Infr_unc_{t-1} + \sum_{j=0}^{p^4} \phi_j \Delta lnPci_unc_{t-1} + \sum_{j=0}^q \phi_j \Delta ec_{t-1} \quad (4)$$

In this case, ϕ is the speed of adjustment, and should be negative and significant. The parameters α_2 to α_3 are coefficients, and are expected to be negative, while α_4 should be positive following the study's set apriori expectations.

5. Results and Discussions

5.1. Descriptive Statistics

The results of the descriptive statistics presented in table 5.1 show the statistical properties of the variables. The measure of the central tendency was first examined with averages of the variables stated as: health outcomes (Hoc: 2.166268), per capita income uncertainty (Pci_unc: 26780.8), exchange rate uncertainty (Exr_unc: 91.80354) and inflation rate uncertainty (Infr_unc: 18.91711). The results equally indicate that Pci_unc has the highest standard deviation, while Hoc registers the least (0.026844). Aside Hoc which is negatively skewed, others are positive. Infr_unc has a value greater than three (3), and is thus leptokurtic. Meanwhile, following the probability values of Jarque-Bera statistic, all variables except Infr_unc are normally distributed.

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Table 5.1. Descriptive Statistics

	Exr_unc	Hoc	Infr_unc	Pcl_unc
Mean	91.80354	2.166268	18.91711	267807.8
Std. Dev.	92.81156	0.026844	16.90501	66447.41
Skewness	0.839392	-0.636898	1.823472	0.534935
Kurtosis	2.889805	1.806418	5.151977	1.681672
Jarque-Bera	4.717433	5.078653	29.88535	4.804350
Probability	0.094541	0.078920	0.000000	0.090521
Observations	40	40	40	40

Source: Authors' computation using Eviews-10

5.2. Unit Root Test:

To avoid spurious empirical analysis, the study conducted stationarity tests on the time series data of macro variables. This was done using Augmented Dickey-Fuller (ADF). Aside from using it to ascertain level of stationarity; the ADF also help to reveal order of integration among the macroeconomic variables. Following the stationarity test outcomes depicted in table 5.2, the order of integration is mixed. That is, at 'levels' and 'first difference' [I (0) and I (1)]. Thus, when the order of integration is in this form, ADRL becomes the appropriately applied technique of analysis.

Table 5.2. Augmented Dickey-Fuller Unit root test

Variable	Stationarity Level	Test Statistic
Health outcomes (Hoc)	I (0)	-3.533083**
Exchange rate uncertainty (Exr_unc)	I (1)	-3.533083**
Inflation rate uncertainty (Infr_unc)	I (0)	-2.938987**
Log Per capita income uncertainty (lnpci_unc)	I (1)	-3.540328**

Null Hypothesis: variable has a unit root significant at 10% (); 5% (**); 1% (***) levels*

5.3. Cointegration Test:

Table 3. Co Following the result of the unit root test, the ARDL framework utilization becomes feasible, and thus proceeds to conduct the cointegration test. Bound test, an integrate part of the ARDL methodology which test for cointegration, is thus applied in this case.

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Table 5.3. Bounds Test for Cointegration

Significance Level	Critical Value		Computed F-Statistics
	Lower I(0) Bound	Upper I(1) Bound	
10%	3.47	4.45	
5%	4.01	5.07	
2.5%	4.52	5.62	18.133573
1%	5.17	6.36	

Null Hypothesis: No long-run relationships exist

Source: Authors' Computation using Eviews-10

The Bounds test output as shown in table 5.3 indicating the existence of cointegration even at 1% level of significance. 1% is asymptotic critical in it's used as significance level. The Bound F-statistic computed is 18.133573, and is greater than 5.17 and 6.36 for lower and upper bounds of the critical value at 1%. The rules of Bounds test state that, if calculated F-Statistics is greater than upper bound value, the null hypothesis should be rejected, otherwise, we do not reject the null hypothesis. This reveals existence of long-run relationship among the focused macroeconomic variables because, the alternate hypothesis holds.

5.4. ARDL Regression Outcomes:

Having established the existence of a long-run relationship among the variables, the study proceeded to estimate the ARDL short-run model, and followed by the long-run version. Table 5.4 shows the short-run analysis. From the findings of the study's short-run ARDL model, the coefficient of exchange rate uncertainty (Exr_unc) is positive and significant. That, as exchange rate increasingly fluctuates upwards, instead of health outcomes being adversely affected, it is otherwise. This is contrary to the expectations. Three basic factors may have played out here. First, the gradual positive effect of National Health Insurance Scheme (NHIS) to enable unhindered access to healthcare services (that is, inclusive health finance) in spite of the probable rising healthcare cost; second, the belief system of some Nigerians orchestrated by their traditions and religions, who are still likely to prefer herbal-care to conventional medicine, and lastly, the healthcare seeking behaviour of Nigerians is likely to skew towards eating healthy and going herbal owing to rising awareness.

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Table 5.4. Short-Run ARDL Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.267523	0.029400	9.099429	0.0000
@TREND	-8.46E-05	1.25E-05	-6.761858	0.0000
D(HOC(-1))	0.231346	0.120091	1.926419	0.0677
D(HOC(-2))	0.094406	0.122126	0.773021	0.4481
D(HOC(-3))	0.113841	0.083733	1.359569	0.1884
D(EXR_UNC)	-9.68E-06	2.95E-06	-3.279768	0.0036
D(EXR_UNC(-1))	2.76E-05	4.71E-06	5.849576	0.0000
D(EXR_UNC(-2))	2.82E-05	4.60E-06	6.118454	0.0000
D(EXR_UNC(-3))	2.94E-05	4.93E-06	5.951501	0.0000
D(LNPCI_UNC)	-0.002425	0.001577	-1.538109	0.1390
D(LNPCI_UNC(-1))	-0.002009	0.001310	-1.533478	0.1401
ECM(-1)	-0.123086	0.013519	-9.104743	0.0000

R² = 0.98; Adj. R² = 0.97; F-Stat. = 149.10 (p-value = 0.00); D.W Stat. = 1.98

Source: Authors' Computation using Eviews-10

Per capita income uncertainty (lnPci_unc) behaviour in the model is insignificant and also not aligning with theoretical projections. This is possibly as a result of the rapid growth in the nation's population without a corresponding increase of the national income, culminating in widespread impoverishment. Thus, healthcare facilities could have been made inaccessible to large number of the populations already impoverished, thereby encouraging seeking healthcare service from alternative sources to improve their health status. The dynamism of the model represented by the ECM (-1) shows a well behaved one. It reveals that, should there be any variation from path of equilibrium, 12.31 percent of the variation would be adjusted in the same year.

Focusing on the outlook of the study's analysis, using displayed statistics, we can depend on the model for further analysis. A good instance is the dynamic coefficient which is rightly indicated (that is, negative as expected) at p-value of 0.00. It is a sign of possible reverting to equilibrium should there be any distortion within a short period. The model's goodness of fit reveals over 95 percent variation in health outcomes is explained in the model. The F-statistic figure shows that, in Nigeria, the independent variables jointly explained HOC at 0.00 significant levels. 1.98 represents the Durbin-Watson (D.W) statistic. It is an indication of absence of autocorrelation in the function.

Table 5.5. Long-Run ARDL Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR_UNC	-0.000335	5.02E-05	-6.662403	0.0000
INFR_UNC	6.77E-05	2.69E-05	2.518747	0.0200
LNPCI_UNC	0.001824	0.013338	0.136742	0.8925

Source: Authors' Computation using Eviews-10

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Having discussed the behaviour of the uncertainty of the model's macroeconomic variables in the short-run, it is expedient to examining their long-run effect as one of research preliminary investigations. Table 5.5 thus, depicts the long-run ARDL findings. The finding shows that the influence of the exchange rate uncertainty is significant and has inverse relationship with health outcomes. This is as projected. Exchange rate instability in an upward manner can adversely affect people's health. The coefficient of the inflation rate uncertainty is positive and significant at 5%. The behaviour of this macroeconomic variable (Infr_unc) in the long run, is synonymous with what exchange rate uncertainty exhibited in the short-run. This can be adduced to the role of NHIS to making healthcare services accessible and affordable to people irrespective of the cost of healthcare caused by inflation rate uncertainty. Besides, it could possibly be that most Nigerians are giving to healthy eating and having affinity for herbal-care. Therefore, the rising cost of healthcare services owing to inflation uncertainty cannot be transmitted to have impacted. However, expectedly, per capita income uncertainty is positively indicated, but not statistically significant. This non-significance is as a result of the continuous dwindling gross national income. Accordingly, Nigerians' welfare generally has indeed been abysmal.

Table 5.6. Granger Causality Outcomes

Null Hypothesis	F-Stats	p-value	Causality Remark
HOC does not Granger Cause EXR_UNC	1.73306	0.1924	Uni-directional
EXR_UNC does not Granger Cause HOC	6.08010	0.0056**	
INFR_UNC does not Granger Cause EXR_UNC	0.84367	0.4392	Non-directional
EXR_UNC does not Granger Cause INFR_UNC	1.09563	0.3462	
LNPCI_UNC does not Granger Cause EXR_UNC	0.87791	0.4251	Uni-directional
EXR_UNC does not Granger Cause LNPCI_UNC	2.49337	0.0981*	
INFR_UNC does not Granger Cause HOC	1.01254	0.3743	Non-directional
HOC does not Granger Cause INFR_UNC	2.18460	0.1285	
LNPCI_UNC does not Granger Cause HOC	5.64344	0.0078**	Bi-directional
HOC does not Granger Cause LNPCI_UNC	5.33314	0.0098**	

Source: Authors' Computation using Eviews-10

Null Hypothesis rejection at 10% () and 5% (**) significant levels*

Table 5.6 displays the findings of the causality test. The Granger causality is an empirical tool used to ascertain cause and effect relation among engaged variables in a study. In this case, it is between health outcomes and macroeconomic uncertainty in line with the study's objective. The outcome from any causality test is essential because, it can go three directions, that is: bi-directional, un-directional and non-directional.

From the outcomes, there were no causal association between Infr_unc and Exr_unc on one hand and between Infr_unc and Hoc on the other hand. It is an indication that, the variables had separate (independent) movements during the years considered (that is, they are non-directional). This shows inflation rate uncertainty does not explain or affect health outcomes.

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However, there is uni-directional association between exchange rate uncertainties to health outcomes on one hand, and exchange rate uncertainty to per capita income on the other hand. These are occasioned by the rejection of null hypotheses at 5% and 10% level of significance respectively. This revealed exchange rate variability prediction of health outcomes during the considered periods. Lastly, a bi-directional association existed between per capita income and health outcomes. This is due to the non-acceptance of the null hypothesis at 5% level of significance. This means both macroeconomic variables (InPci_unc and Hoc) Granger causes each other at significant p-value.

5.5 Diagnostic Tests:

The study's ARDL model requires validation, which is known as post estimation analysis. Post estimation analysis involves the use of residual diagnostic checks like serial correlation LM test for heteroscedasticity, and stability test utilizing cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares (CUSUMQ).

Table 5.7. Heteroscedasticity: Breusch-Godfrey Serial Correlation LM Test

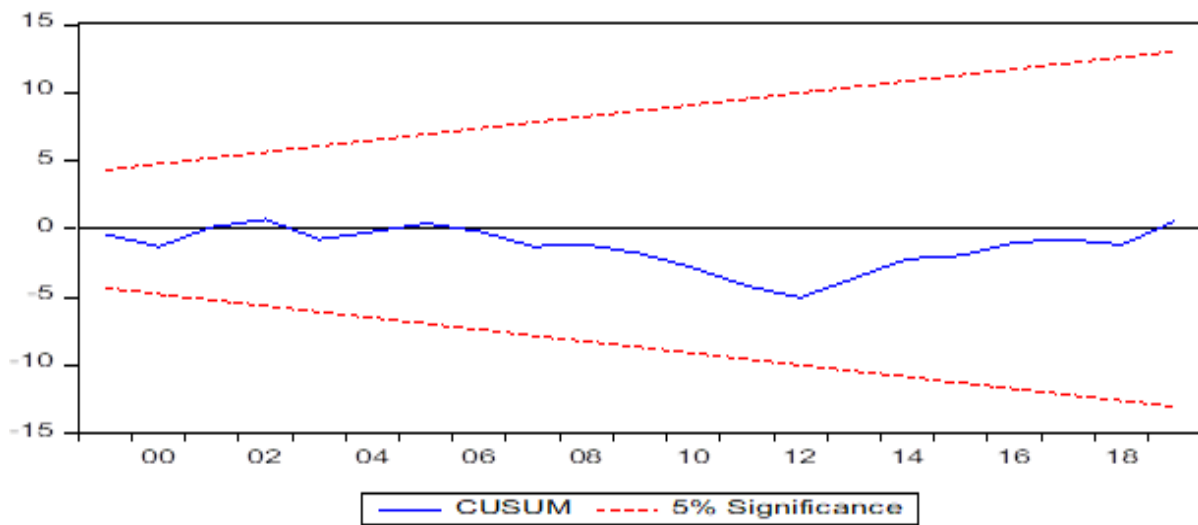
F-statistic	0.896080	Prob. F(14,21)	0.5745
Obs*R-squared	13.46323	Prob. Chi-Square(14)	0.4904

Source: Authors' Computation using Eviews-10

Null Hypothesis rejection at 10% () and 5% (**) significant levels*

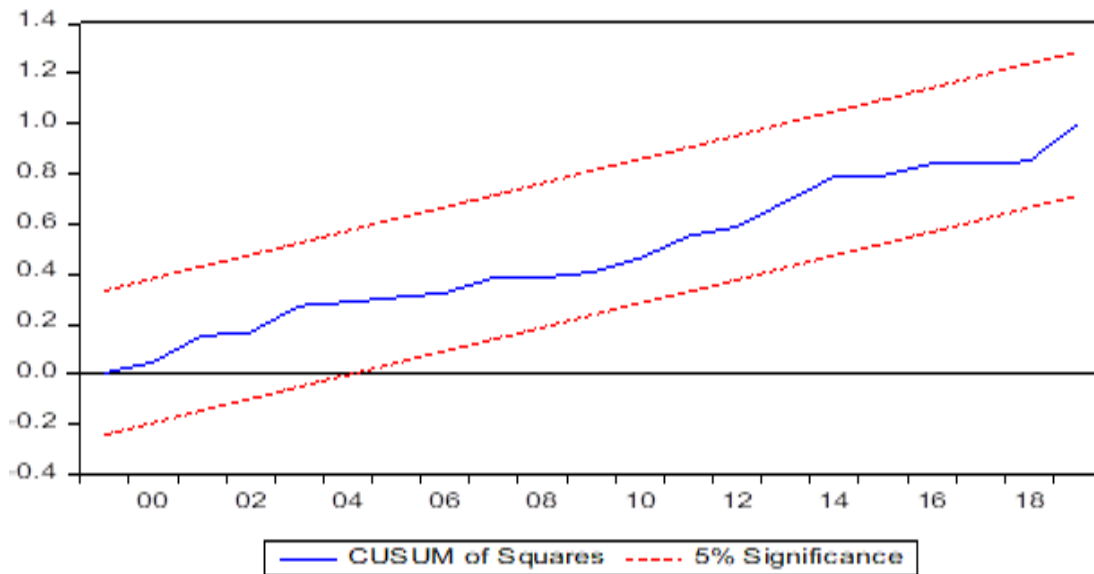
The result as displaced in table 5.7 shows that the Breusch-Godfrey test reveals the absence of heteroscedasticity in the model. The Chi-square probability value (0.4904) is above 5%. So, the null hypothesis of no serial correlation cannot be rejected.

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Source: Authors' Computation using Eviews-10

Figure 5. Cumulative Sum of Recursive Residuals (CUSUM)



Source: Authors' Computation using Eviews-10

Figure 6. Cumulative Sum of Squares of tests (CUSUMQ)

6. Conclusions and Policy Recommendations:

The focus of the study's analysis is the impact of the macroeconomic uncertainty on health outcomes in Nigeria between 1980 and 2019. Thus, for the study to be both scientifically and empirically grounded, it is underpinned by rational expectation theory. The theory had been a foundation for random walk akin to unpredictable trending of macroeconomic variables, which in other words is uncertainty. Uncertainty was discovered to have influenced nations' economic activities. This has necessitated the focus of this analysis.

Having established a mixed order of integration [I (0) and I (1)] via stationarity test, the study thus, adopted the ARDL method of analysis. The model concerned has the index of health outcomes in Nigeria as the dependent variable, while the explanatory variables include the exchange rate uncertainty, the inflation rate uncertainty and the natural logarithm of per capita income uncertainty. The study's findings revealed that, the exchange rate uncertainty significantly impact the index of health outcomes in Nigeria. This finding is in line with Guney (2020) where the exchange rate uncertainty was significant and inverse in its relationship with private investment in Turkey and Raji (2020). However, inflation rate uncertainty was not consistent with a priori expectation, but significant. Per capita income uncertainty had no effect in the model at all.

The policy implications from these findings are as follows: one, the variability of the exchange rate is detrimental to health of Nigerians. As a corollary, indirectly, it becomes injurious to human capital via fallen health status. Since Nigeria is an import-dependent economy, with an unstable rising exchange rate, it could translate into the rising cost of healthcare service. This could make healthcare service not affordable or inaccessible to a lot Nigerians. To mitigate this adverse effect, policy makers should weaken foreign currencies demand via inward looking approach via local substitution of imported healthcare materials. This shall be beneficial in two ways: first, foreign currencies demand will reduce, and second, it will bring about diversification of the nation's economy.

Second, from the behaviour of the inflation rate uncertainty in the model; it implies effectiveness of the operational healthcare policies. One such policy is NHIS. NHIS by its nature guarantees financial protection to people against rising healthcare cost; thereby having unhindered access to healthcare services. However, the scheme's coverage rate is currently too low. Policy makers should make effort to broaden the coverage, thereby incorporate all Nigerians irrespective of their social strata. Lastly, the insignificance of natural logarithm of per capita income uncertainty but indicated as expected in the long-run model, has remarkable implication. It indicates wide spread impoverishment in the face of dwindling national revenue in respect to a growing population. Thus, to improve the base for generating revenue, there is need to fully diversify the nation's economy so that besides oil revenue, there could be varied key national revenue sources.

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