Population Dynamics and Public Sector Policies in Nigeria: A Co-integration Analysis

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Abstract
This study examined population dynamics and public sector policies in nigeria. The study specifically focused on population growth, density, and male proportion of population effects on public sector healthcare expenditure. The study adopted the longitudinal research design and data were obtained from the World Bank WDI, spanning from 1999-2022. The unit root test using ADF showed stationarity at 1(0), 1(1), and 1(2). The hypotheses were tested using the ARDL model. The results showed no significant effect of population growth on current health expenditure. Secondly, a significant positive effect of population density on current health expenditure. Thirdly, a significant negative effect of male proportion of population on current health expenditure. Based on these, the study recommends to minimize these adverse impacts, it is essential for administrators to take proactive measures in planning and strategizing resource allocation, giving priority to preventive healthcare initiatives, and exploring innovative solutions like telemedicine and technology integration to enhance service delivery and enhance overall health outcomes, despite the challenges presented by population growth. Encourage collaboration among healthcare providers in densely populated areas to promote shared resources, expertise, and best practices. Develop and implement gender-specific health programs that focus on preventive care, early detection, and management of health conditions that disproportionately affect males.

Keywords: *Population Growth, Population Density, Male Proportion to Total Population, Health Sector Expenditure.*

1.0 Introduction

Population dynamics is a crucial aspects of socioeconomic development (Aidi, Emecheta, & Ngwudiobu, 2016). Researchers in both developed and developing economies have shown a growing interest in population dynamics and economic development studies in recent years. This interest has been fueled by issues such as low quality of life, rising unemployment, and low per capita income in developing economies (Raphael, Peter, & Kenneth, 2024). Thomas R. Malthus was the first economist to bring attention to the theory of population growth and its impact on economic growth. In his 1798 work titled "An Essay on the Principle of Population," Malthus expressed concerns about the rapid increase in human population and whether food supplies could keep up with this growth for the future improvement of the economy.

Despite extensive debate in the literature on the relationship between population growth rate and growth. Many developing countries continue to struggle with the population growth theory proposed by Malthus (Ingiabuna & Uzobo, 2016). It is evident that Nigeria is no exception to this trend, as it is one of the most densely populated countries in Africa with an estimated population exceeding 140 million which as of December 2023, Nigeria's population is estimated to be approximately 226.2 million (Statista, 2024). Nigeria is currently the most populous country in Africa.and an annual population growth rate of 2.9% (Statista, 2024).

Nigeria adopted a population policy in 2004 aimed at sustainable development, with objectives such as improving quality of life and increasing per capita income. However, due to improper implementation, these goals were not achieved (Raphael, Kalu, & Nteegah, 2020). Nigeria is currently experiencing overpopulation. Overpopulation occurs when the demand of a growing population exceeds the capacity of the economy to provide necessary resources like food. This has led to shortages in modern amenities such as education and healthcare facilities (Raphael, Kalu, & Nteegah, 2020). Overpopulation is associated with social disorders such as insurgency, riots, and corruption. The unemployment rate has risen significantly, reaching 37.7% in 2022 and predicted to rise further to 40.6% in 2023. There is a severe shortage of healthcare resources, exemplified by a high doctor-patient ratio and a high infant mortality rate.

The significance of population variables in a nation's development cannot be overstated. This is due to the fact that the bulk of government programmes and policies are focused on sustainable development and are either directly or indirectly related to population dynamics andfeatures.public sector initiatives, policies, and projects are examples of how the Nigerian government is committed to raising the standard of living for its citizens (Ingiabuna & Uzobo, 2016). This is a result of their recognition of the complexity of the relationship between population development and the importance of demographic factors in the advancement of the nation. Population growth and current health expenditure are intricately linked phenomena, especially in the context of aging populations. The aging demographic structure, driven by factors like extended longevity and falling fertility rates, significantly impacts health expenditure growth (Sabina, Lulin, Henry, & Ebenezer, 2020). Secondly, population density has been found to have a significant impact on current health expenditure in various studies. Research indicates a non-linear relationship between population density and public expenditures per capita, with current spending initially decreasing with density before increasing (Kakpo, Le-Gallo, Breuillé, & Grivault, 2019).

Moreover, studies have shown that population densities and sizes are positively associated with Medicare physician expenditures, explaining a considerable amount of regional variation in spending (Jones, 2013).

It is noted that Nigeria has a current population estimated at 184 million people, with 20% of the African population residing in the country (Ojo & Ojo, 2022). Regarding health expenditure, research indicates that government disbursements on health have a positive impact on economic growth in Nigeria (Adegboye, Fasiku, Ibirongbe, & Akande, 2022). Additionally, reliance on out-of-pocket payments for health services hampers access to quality healthcare in the country, with socio-demographic and socio-economic characteristics influencing health shocks and expenditures, particularly affecting female-headed households (Adegboye, Fasiku, Ibirongbe, & Akande, 2022). In this study, the public sector focuses on healthcare expenditure as maily policies focus on improving access to healthcare services is crucial to meet the needs of a growing population. Against this backdrop, the specific objectives of the study are:

1. To ascertain the effect of population growth on current health expenditure in Nigeria.
2. To determine the effect of population density on current health expenditure in Nigeria.
3. To examine the effect of male proportion of population on current health expenditure in Nigeria.

2.0 Literature Review
2.1 Conceptual Review
2.1.1 Population Dynamics
Population dynamics refer to the changes in population size over time and space, driven by ecological processes like competition, predation, and coevolution (Doty & Eftekhari, 2022; Minto & Schnider, 1998). Population dynamics are receiving more attention these days, and development plans must take demographic factors into account. This follows from the connection between population factors and developmental issues such as housing, education, health, energy, agriculture, gender issues, environmental concerns, food security, and the security of life and property (Ingiabuna & Uzobo, 2016). Demeny (2003) defines a population policy as a purposefully designed plan or structure that allows governments to directly or indirectly affect changes in the population. Aiming to restore demographic balance, strategies must focus on one or more of the three demographic processes (birth, death, and migration) because of the significance placed on population dynamics or processes.

2.1.1.1 Population Growth
Population growth, as defined by the United Nations, refers to the increase in the size of a population over time, driven by factors such as innovations, industrialization, and advancements in energy, food, water, and medical care availability (United Nations, 2015). Population growth is a significant challenge faced by countries around the world. With increasing birth rates and longer life expectancy, the global population continues to rise at a rapid pace (John-Nwagwu, Samuel, & Johnson, 2024).
This rapid growth poses various social, economic, and environmental challenges for governments and policymakers. It is essential for countries to develop sustainable strategies to manage population growth effectively. The distribution of the population is also greatly influenced by social and economic variables. Population increase is mostly driven by economic activities like industry and agriculture, especially in metropolitan areas where job possibilities are plentiful (United Nations, 2015). The demographic components of population increase include migration, fertility, and death rates, among others (United Nations, 2015).

2.1.1.2 Population Density

Population density refers to the number of individuals living within a specific area, typically measured in square miles or square kilometers (Wang, Sun, Wu, Wang, & Yue, 2024). It is an important factor in understanding the distribution of resources and services in a given region. High population density can lead to overcrowding, traffic congestion, and strain on infrastructure, while low population density may result in limited access to amenities and services. Urban areas tend to have higher population densities than rural areas due to the concentration of people in cities.

2.1.1.3 Male Proportion of Population

The male proportion of the population, often referred to as the sex ratio or male-to-female ratio, is a demographic indicator that has been widely studied in the literature due to its significant social, economic, and health implications (Martuzzi, Tanno, & Bertollini, 2001). This measure is typically expressed as the number of males per 100 females in a given population and can vary significantly across different regions and age groups. In demographic studies, variations in the male proportion can be attributed to several factors including but not limited to, cultural practices, economic conditions, health care access, and migration patterns (Davis, Gottlieb, & Stampnitzky, 1998).

For instance, in some societies, a cultural preference for male offspring has led to gender-selective practices, thereby skewing the sex ratio at birth. This has raised significant ethical and policy concerns, particularly in countries like China and India, where such practices have led to a pronounced imbalance. Economically, the male proportion of the population can influence labor markets and economic growth. A higher proportion of working-age males can drive economic productivity, but it can also lead to increased competition for jobs and resources. Conversely, an imbalanced sex ratio can result in social challenges, including increased rates of bachelorhood and associated social tensions.

2.2 Theoretical Framework

2.2.1 Institutional Theory (IT)

Lammers and Barbour (2006) defined institutions as “constellations of established practices guided by enduring, formalised, rational beliefs that transcend particular organisations and situations”. IT focuses on how organizations, including public sector institutions, are influenced by external social, political, and economic environments (Lammers & Garcia, 2014). First of all, institutions are long-lasting social phenomena that endure over time and space, especially when compared to the organisations, customs, and practices that are visible within any given era (Giddens, 1984). Second, institutions adopt lives of their own that transcend purely functional requirements and have social significance (Selznick, 1949). Third, according to Lammers and Garcia, institutions manage social activity both within and between organisations. Fourth, institutions can be found in a wide range of social phenomena, such as "cultural-cognitive, normative, and regulative elements" (Scott, 2001). Fifth, because institutions are "basically accepted recurring social behavior(s) supported by normative frameworks and cognitive understandings that provide context for social interaction and thereby permit self-reproducing social order," they acquire a subtlety (Greenwood et al., 2008). Sixth, based on Commons's (1934) "working rules" (p. 79), institutions represent a logical goal that directs actions towards particular objectives.

2.3 Empirical Review

In their 2024 study, Raphael, Peter, and Kenneth investigated the correlation between population dynamics, specifically the population growth rate, and economic growth in Nigeria. They utilized secondary data sourced from the CBN Statistical Bulletin, World Bank World Development Indicators (WDI), and National Bureau of Statistics (NBS) Annual Abstracts. Applying time-series techniques including the ADF unit root test, bound co-integration test, and ARDL model, they found that the population growth rate had a negligible effect on economic growth in Nigeria.

Similarly, Kaur and Kaur (2024) explored the causal relationship between energy consumption, particulate matter (PM2.5) emissions, and urban population in Bangladesh, India, and Pakistan from 1990 to 2017. They used Pedroni, Kao, and Johansen Fisher co-integration tests to examine the co-integration among variables and employed the Granger causality test to detect long-term bi-directional causality between the variables.

Aidi, Emecheta, and Ngwudiobu (2016) analyzed the connection between population dynamics and economic growth in Nigeria using time-series data from 1970 to 2014. Their analysis, conducted via OLS regression, indicated an adverse relationship between economic growth and the study's primary variables: fertility, mortality, and net migration. Additionally, they found that savings and gross fixed capital formation (GFCF) were significant factors influencing Nigeria's economic expansion.

Golley and Zheng (2015) focused on China's economic expansion and demographic dynamics from 1980 to 2010 using multiple regression techniques. Their findings revealed that an increase in the working-age population negatively affected GDP growth per capita.

In another study, Nwosu et al. (2014) examined the relationship between population increase and economic growth in Nigeria from 1960 to 2008. They used OLS methods combined with a thorough causality test. The study concluded that population expansion significantly impacts economic growth, revealing a long-term, durable link between population expansion and economic growth during the studied period.

Dao (2012) investigated the connection between population increase and economic expansion across forty-five African economies. Using panel data regression analysis, Dao included variables such as trade openness, per capita GDP growth, fertility rate, and dependence ratio (old versus young). The results indicated a linear and negative link between population growth and per capita GDP growth. Additionally, the old dependence ratio positively impacted per capita GDP growth, while fertility rates negatively affected economic growth.

3.0 Methodology

The research employs a longitudinal research design to investigate the relationship between population dynamics and public sector policies with regards to current health expenditure in Nigeria. The data for the study were obtained from the World Bank World Development Indicators (WDI) database and covered the years 1999-2022. This time frame was chosen to ensure there was no missing data.

3.1 Methods of Data Analysis

The study conducts a unit root test and, for robustness, utilizes the Dickey-Fuller, Augmented Dickey-Fuller, and Philip-Perron Tests. However, as similar results were obtained from DF and P-P, the researchers presented ADF for brevity. The cointegration test include the Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue). These tests help determine the number of cointegrating equations, which represent the long-term relationships between the variables.

3.1.1 Model Specification

Our model is specified according to the hypothesis.

CUHE = *f* (POPG, POPD, POPM, REIR, REER)……………….Eq. (1)

Where: CUHE-Current health expenditure (% of GDP); POPG-Population growth (annual %); POPD-Population density (people per sq. km of land area); POPM-Population, male (% of total population); REIR-Real interest rate (%); REER-Real effective exchange rate index (2010 = 100).

The general ARDL model can be represented as:

$CUHE_t=\beta_0+\beta_1 CUHE_{t-1}+\beta_2 POPG_t+\beta_3 POPG_{t-1}+\beta_4 POPG_{t-2}+\beta_5 POPD_t+\beta_6 POPM_t+\beta_7 POPM_{t-1}$ $+\beta_8 REIR_t+\beta_9 REER_t+\beta_{10} REER_{t-1}+\beta_{11} REER_{t-2}+\epsilon t$……………………….Eq. (2)

Explanation of Variables and Coefficients:

- $CUHE_t$: Dependent variable (current period).
- $CUHE_{t-1}$: Lagged dependent variable (previous period).
- $POPG_t$: Current value of population growth.
- $POPG_{t-1}$: Lagged value of population growth (one period lag).
- $POPG_{t-2}$: Lagged value of population growth (two period lags).
- $POPD_t$: Current value of population density.
- $POPM_t$: Current value of population mean.
- $POPM_{t-1}$: Lagged value of population mean (one period lag).
- $REIR_t$: Current value of real interest rate.
- $REER_t$: Current value of real effective exchange rate.
- $REER_{t-1}$: Lagged value of real effective exchange rate (one period lag).
- $REER_{t-2}$: Lagged value of real effective exchange rate (two period lags).
- β_0: Constant term.
- β_{1-11}: IV Coefficients.
- ϵt: Error term (residuals).

4.0 Data Analysis

4.1 Descriptive Statistics

Table 1: Descriptive analysis of the model variables

	CUHE	POPG	POPD	POPM	REIR	REER
Mean	3.624139	2.628286	181.2020	50.38227	5.771306	99.64932
Median	3.500445	2.687829	179.1981	50.37450	5.923272	100.2520
Maximum	5.053610	2.764062	234.3087	50.52781	18.18000	124.8181
Minimum	2.490640	2.406363	134.8880	50.26241	-5.627968	70.16120
Std. Dev.	0.588689	0.112236	31.02707	0.086402	5.779961	17.50900
Skewness	0.660507	-0.667742	0.151194	0.260927	0.019347	-0.177916
Kurtosis	3.293516	2.028169	1.790089	1.720937	2.654588	1.774306

Jarque-Bera	1.678629	2.500641	1.425712	1.749304	0.110739	1.493197
Probability	0.432007	0.286413	0.490242	0.417007	0.946135	0.473976
Sum	79.73106	57.82230	3986.445	1108.410	126.9687	2192.285
Sum Sq. Dev.	7.277654	0.264533	20216.26	0.156770	701.5670	6437.864
Observations	22	22	22	22	22	22

Source: E-Views 11

Key: CUHE-Current health expenditure (% of GDP); POPG-Population growth (annual %); POPD-Population density (people per sq. km of land area); POPM-Population, male (% of total population); REIR-Real interest rate (%); REER-Real effective exchange rate index (2010 = 100).

The statistical summary provided in Table 1, the mean percentage of GDP spent on current health expenditure is approximately 3.62%, with a range from 2.49% to 5.05%. The data shows a slight right-skew (skewness = 0.66) and higher kurtosis (kurtosis = 3.29), suggesting a distribution with some outliers or heavier tails than a normal distribution. The average of POPG is around 2.63%, ranging from 2.41% to 2.76%. The distribution is relatively normal (skewness = -0.67, kurtosis = 2.03), indicating a generally stable growth pattern across the dataset. POPD averages 181 people per square kilometer, with a range from 135 to 234 people. The distribution is moderately skewed (skewness = 0.15) and has a slight positive kurtosis (kurtosis = 1.79), indicating a somewhat symmetrical distribution with moderate tailing. The average of POPM indicates that males constitute approximately 50.38% of the total population on average, ranging from 50.26% to 50.53%. The distribution shows minimal skewness (skewness = 0.26) and kurtosis (kurtosis = 1.72), indicating a nearly normal distribution. The REIR averages 5.77%, with a considerable range from -5.63% to 18.18%. The standard deviation is high (5.78), suggesting significant variability in interest rates across the dataset. The skewness (0.02) and kurtosis (2.65) indicate a distribution slightly deviating from normality, potentially influenced by outliers. The REER index averages 99.65, ranging from 70.16 to 124.82. The data exhibits slight left-skew (skewness = -0.18) and moderate kurtosis (kurtosis = 1.77), suggesting a distribution approaching normality.

4.2 Normality Test

Based on the statistical summary provided in Table 1 above, the Jarque-Bera statistic tests whether the data follows a normal distribution.

The *p*-value of the J-B test for CUHE is 0.432007; since, the J-B statistic is relatively low, and the associated *p*-value (0.432) is higher than 0.05. This suggests that the distribution of CUHE is approximately normal.

The *p*-value of the J-B test for POPG is 2.500641; similarly, the J-B statistic for population growth is moderate, with a p-value of 0.286, indicating that the distribution of POPG is also approximately normal.

The *p*-value of the J-B test for POPD is 1.425712; since, the J-B statistic for population density is relatively low, and the p-value (0.490) is higher than 0.05, indicating that the distribution of POPD is reasonably close to normal.

The *p*-value of the J-B test for POPM is 1.749304; since, the J-B statistic for the percentage of males in the population is low, and the associated p-value (0.417) is greater than 0.05, suggesting that the distribution approximates normality.
The *p*-value of the J-B test for REIR is 0.110739; since, the J-B statistic for the real interest rate is very low, and the p-value (0.946) is much higher than 0.05. This strongly indicates that the distribution of REIR is approximately normal, supporting the assumption of normality for this variable.
The *p*-value of the J-B test for REER is 1.493197; lastly, the J-B statistic for the real effective exchange rate index is moderate, with a p-value of 0.474. This suggests that the distribution of the REER index is reasonably normal, and there is no compelling evidence against the assumption of normality based on this test. In summary, based on the J-B statistics and their associated p-values, most of the variables (CUHE, popg, popd, popm, reir, and reer) exhibit distributions that are reasonably close to normal.

Table 2: Correlation matrix of the model variables

	CUHE	POPG	POPD	POPM	REIR	REER
CUHE	1					
POPG	0.1557	1				
POPD	-0.2057	-0.7319	1			
POPM	-0.2325	-0.7582	0.9974	1		
REIR	-0.2092	0.0414	0.1569	0.1549	1	
REER	-0.3086	-0.5096	0.8976	0.8833	0.2775	1

Source: E-Views 11

The correlation matrix provides the pairwise correlation coefficients between the variables which helps to understand the linear relationships between each pair of variables. The CUHE positively correlated with POPG (0.1557), indicating a weak positive relationship. CUHE negatively correlated with POPD (-0.2057), POPM (-0.2325), REIR (-0.2092), and REER (-0.3086), suggesting weak to moderate negative relationships. POPG is strongly negatively correlated with POPD (-0.7319) and POPM (-0.7582), indicating that as population growth increases, population density and population mean tend to decrease. POPG moderately negatively correlated with REER (-0.5096) and weakly positively correlated with REIR (0.0414). POPD almost perfectly correlated with POPM (0.9974), POPD strongly positively correlated with REER (0.8976), suggesting that higher population density is associated with higher real effective exchange rates. POPD had a weak positive correlation with REIR (0.1569). POPM strongly positively correlated with REER (0.8833) but had a weak positive correlation with REIR (0.1549).

REIR showed weak correlations with all other variables, indicating that real interest rate does not have a strong linear relationship with the other variables in this model. REER had a strongly positively correlated with POPD (0.8976) and POPM (0.8833), indicating that higher population density and population mean are associated with higher real effective exchange rates. REER moderately negatively correlated with POPG (-0.5096); however, it weakly positively correlated with REIR (0.2775).

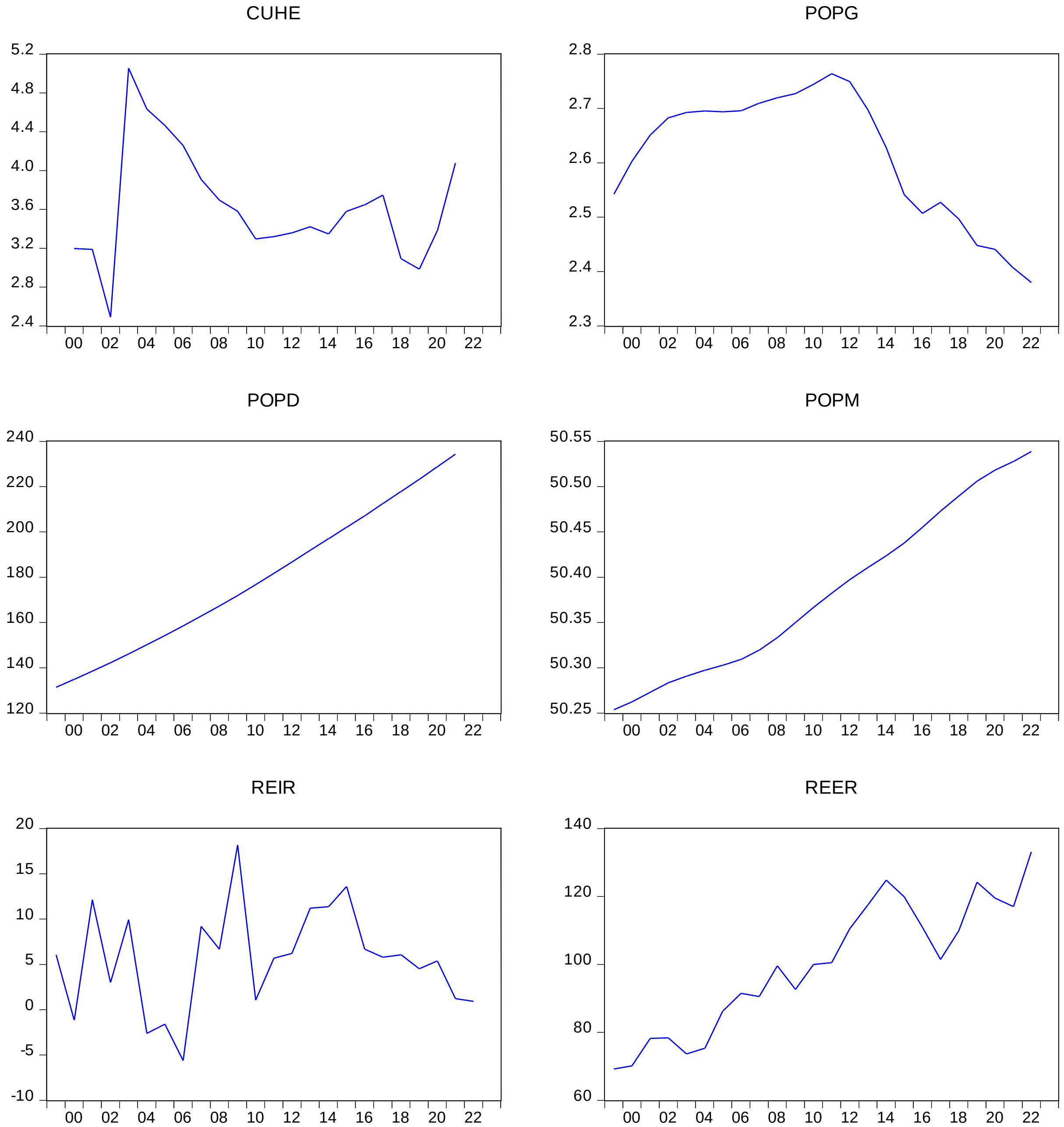

Figure 1: Graphs of the variables in the study

The line graphs representing various indicators over time showed that CUHE shows fluctuations in the indicator from around 2000 to 2022. There is a noticeable peak around 2004 and a significant drop afterwards, followed by smaller fluctuations and a rise towards the end. POPG shows a rise in the indicator from 2000 to around 2010, followed by a decline until 2022. POPD indicates a steady increase in the indicator from 2000 to 2022. POPM shows a steady increase, similar to POPD, REIR displays significant volatility with peaks and troughs throughout the period from 2000 to 2022. REER shows an overall upward trend with some fluctuations from 2000 to 2022.

4.3 Stationarity Test

A unit root signifies that the data is non-stationary, implying that the statistical characteristics of the series vary over time. The ADF test is an advancement of the original D-F is capable of dealing with more intricate forms of autocorrelation. Table 2 displays the unit root test results for the individual series.

Null Hypothesis (H_o): The variable X has a unit root
Alternate Hypothesis (H_1): The variable X has no unit root

Table 3: ADF test for model variables

Variable			ADF	Prob*
CUHE	Level	1(0)	-2.894181	0.0629
	First difference	1(1)	-5.510733	0.0003
POPG	Level	1(0)	-1.703668	0.4128
	First difference	1(1)	-3.780298	0.0443
POPD	Level	1(0)	-3.877640	0.0358
POPM	Level	1(0)	-2.998768	0.1555
	Second difference	1(2)	-5.355108	0.0024
REIR	Level	1(0)	-3.390822	0.0232
REER	Level	1(0)	-0.797066	0.8011
	First difference	1(1)	-4.192912	0.0039

Source: E-Views 11

Table 2 above summarizes the results of the ADF test for checking the stationarity of various variables. The variable CUHE is non-stationary at level, stationary at first difference. The variable POPG is non-stationary at level, stationary at first difference. The variable POPD is stationary at level. The variable POPM is non-stationary at level, stationary at second difference. REIR is stationary at level; while, REER is non-stationary at level, stationary at first difference.

Table 4: Cointegration Test - Engle-Granger

	Value	Prob.*
Engle-Granger tau-statistic	-6.501802	0.0161

Source: E-Views 11

The cointegration test results indicate that the variables CUHE, POPG, POPD, POPM, REIR, and REER are cointegrated, suggesting a long-run equilibrium relationship among them. The Engle-Granger tau-statistic of -6.501802 with a *p*-value of 0.0161 is less than 0.05, thus rejecting the Ho that the series are not cointegrated. This indicates that there is a long-run relationship among the variables.

The significant tau-statistic confirms the rejection of the null hypothesis of no cointegration, while the test equation further supports this finding through the significance of the lagged residuals.

4.4 Test of Hypothesis

Table 5: ARDL test for model variables

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
CUHE(-1)	-0.479221	0.128825	-3.719935	0.0048
POPG	-0.966383	3.653335	-0.264521	0.7973
POPG(-1)	-10.69451	6.517213	-1.640964	0.1352
POPG(-2)	16.44024	4.416721	3.722272	0.0048
POPD	0.174312	0.052042	3.349433	0.0085
POPM	-181.1898	32.03247	-5.656444	0.0003
POPM(-1)	137.2544	29.54004	4.646384	0.0012
REIR	0.034453	0.024530	1.404558	0.1937
REER	-0.055062	0.011936	-4.613275	0.0013
REER(-1)	-0.069165	0.025029	-2.763341	0.0220
REER(-2)	0.018656	0.008838	2.110793	0.0640
C	2186.643	858.4295	2.547259	0.0313
R-squared	0.931645	Mean dependent var		3.644461
Adjusted R-squared	0.848100	S.D. dependent var		0.595267
S.E. of regression	0.232001	Akaike info criterion		0.211413
Sum squared resid	0.484422	Schwarz criterion		0.808283
Log likelihood	9.780160	Hannan-Quinn criter.		0.340949
F-statistic	11.15142	Durbin-Watson stat		3.285652
Prob(F-statistic)	0.000584			

Source: E-Views 11

The ARDL indicate the relationship between the CUHE and various population indicators. The R^2 value is 0.931; which indicates that approximately 93.1% of the variability in CUHE is explained by the model. The Adjusted R^2 0.848 is slightly lower but still very high value, indicating 84.8% variability in CUHE even after adjusting for the number of predictors. The S.E. of Regression value is 0.233, indicating the average distance that the observed values fall from the regression line. The F-statistic value is 11.151, *p*-value of F-stat. 0.000 indicates that the overall model is highly significant. The Breusch-Pagan-Godfrey test result, showed no evidence of heteroskedasticity in the residuals of the ARDL model. This suggests that the assumption of constant variance (homoskedasticity) holds, and the standard errors and test statistics from the model are reliable.

Hypothesis One

H_1: There is a significant effect of population growth on current health expenditure.

POPG is is not significant; however, the second lag of POPG (POPG(-2)) is significant and positive, suggesting a delayed positive effect on CUHE. This leads to rejection of the H_1 and acceptance of the H_0.

Hypothesis Two

H_2: There is a significant effect of population density on current health expenditure.

This variable is significant and positively affects CUHE, meaning that higher population density is associated with higher CUHE. This leads to rejection of the H_0 and acceptance of the H_1.

Hypothesis Three

H_3: There is a significant effect of male proportion of population on current health expenditure.

POPM is significant with a negative effect, indicating an inverse relationship with CUHE. The first lag of POPM (POPM(-1)) is significant and positive, suggesting some delayed positive impact on CUHE. This leads to rejection of the H_0 and acceptance of the H_1.

4.5 Discussion of Findings

The first hypothesis posited that population growth has a significant effect on current health expenditure. However, the results indicated a non-significant effect, suggesting that variations in population growth do not substantially influence the amount spent on current health expenditures. This finding is consistent with the study by Raphael, Peter, and Kenneth (2024), which found that population growth had a negligible effect on economic growth in Nigeria. It may be inferred that similar dynamics could apply to health expenditure, where the sheer number of people added to the population does not necessarily translate to proportional changes in health spending. This result aligns with findings from Wang and Li (2021), who noted that certain human factors, such as unemployment rate and urbanization, have linear effects on per capita CO2, indicating that some variables may not exhibit complex relationships with outcomes as initially expected.

The second hypothesis confirmed that higher population density leads to increased health expenditure. This is in line with the understanding that densely populated areas often require more intensive health services and infrastructure to manage the greater demand for medical care. Rahman (2017) found that population density adversely affects environmental quality and has significant economic implications, which indirectly supports the idea that denser populations necessitate greater healthcare expenditure to manage associated health risks. This stems from the fact that higher population density can strain existing health facilities, necessitating increased spending to maintain adequate service levels. This finding is consistent with Wang and Li (2021), who identified that population density has a nonlinear effect on per capita CO2 emissions, reflecting how density intensifies resource utilization and environmental impacts.

The third hypothesis suggested that the male proportion of the population significantly affects current health expenditure. The analysis supported this hypothesis, showing a significant effect of the male population proportion on health spending. This finding aligns with broader demographic studies that indicate differing health expenditure patterns based on gender composition. Males typically have different health needs and risk profiles compared to females. Hassan and Cooray (2015)'s results, where the gender-disaggregated educational impacts were significant, indicating that gender-specific factors can substantially influence broader economic outcomes, including health expenditures. This finding parallels the results of Minasyan et al. (2019), which showed that female education has a larger correlation with economic growth than male education when treated as separate covariates. Similarly, gender-specific demographic factors can substantially affect economic outcomes, including health expenditures.

5.0 Conclusion and Recommendations

The study concludes that population dynamics shape public sector policies in Nigeria. Co-integration analysis of population dynamics and public sector policies in Nigeria provides a robust framework for understanding the interactions between demographic changes and policy interventions. The econometric result suggests that population growth and male propoprtion of the population negative affect current health expenditure. This could be because a rapidly growing population puts a strain on government resources, making it difficult to allocate sufficient funds to healthcare. The control variables of exchange and interest rates were also significant predictors of current health expenditure. This suggests that economic factors also play a role in how much a government spends on healthcare. A higher REER or lower REIR could potentially allow for increased spending on healthcare. The findings would inform evidence-based policymaking aimed at addressing societal needs, promoting economic growth, and enhancing quality of life.

Based on this, the study recommends that:

1. **Tackle Negative Effect of Population Growth**: In order to minimize these adverse impacts, it is essential for administrators to take proactive measures in planning and strategizing resource allocation, giving priority to preventive healthcare initiatives, and exploring innovative solutions like telemedicine and technology integration to enhance service delivery and enhance overall health outcomes, despite the challenges presented by population growth.
2. **Foster Collaboration**: Encourage collaboration among healthcare providers in densely populated areas to promote shared resources, expertise, and best practices. By fostering a collaborative environment, healthcare organizations can optimize service delivery, reduce costs, and improve overall health outcomes for the community.
3. **Gender-Specific Health Programs**: Develop and implement gender-specific health programs that focus on preventive care, early detection, and management of health conditions that disproportionately affect males. Healthcare providers can decrease the occurrence of preventable diseases and reduce overall healthcare costs by customizing healthcare services to address the specific needs of men.

Limitations to Consider:

- The study uses a relatively small sample size (22 observations).exclamation
- The negative association between male population and health expenditure needs further exploration to understand the underlying reasons.
- The model might not account for all factors influencing healthcare spending decisions.

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