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Impacts of Population Dynamics on Health in Nigeria Economy

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Abstract: *The study investigates the impact of population dynamics on health in Nigeria. The study employed the use time series secondary data from 1980 to 2018. The Augmented Dickey Fuller test for unit roots indicates that log life expectancy at birth (LOGLEXB), log population LOGPOP), gross saving rate (GSR) and birth rate (BR) stationary at levels, while percentage access to basic sanitation and total labour force participation rate (TLFPR) stabilized at second difference. The study therefore used ordinary least square method for the model estimation. The results of the findings are as follows: there exists a positive and significant relationship between percentage access to basic sanitation and life expectancy within the period of study; there exists a positive and significant relationship between gross saving rate and life expectancy within the period of study; there exists a negative and insignificant relationship between total labour force participation rate and life expectancy within the period of study; and finally, there exists a negative and insignificant relationship between birth rate and life expectancy within the period of study. The following recommendations are therefore suggested: that government has to manage the population of its citizens in such a way that it will improve their life expectancy – a measure of good health; that assurance of access to improved sanitations programs such as provision of modern toilets, and provision of pipe borne water by government will enhance increase life expectancy of the citizens; that government should improve savings among the citizens for the purpose of increase life expectancy and good health of the populace; that government should embark on improved health of the citizens in order to enhance total labour force participation rate. for the purpose of improved standard of living and increase in output; and that government should improve on maternal productivity programmes so as to enhance increase life expectancy at birth.*

Keywords: *Birth rate, Gross saving rate, Population growth, Life expectancy at birth, Total labour force participation rate*

I. Introduction

In 2021, Nigeria's population was estimated to amount to 213 million individuals. Between 1965 and 2021, the number of people living in Nigeria regularly increased at a rate above two percent. In 2020, the population grew by 2.58 percent compared to the previous year. Nigeria is the most populous country in Africa (Doris, 2022).For longevity or life expectancy (LEB), which refers to the average number of years an infant is expected to live if mortality patterns at the time of birth remains constant in the future (World Bank, 2016). It is the average-period that a person is expected to live as determined taking account of current economic situation. This also reflects the overall mortality level of a population, and summarizes the mortality pattern that prevails across all age groups (WHO, 2006). It also indicates the number of years an infant would live provided the patterns of mortality continues at the time of birth were to stay the same throughout his life. Hence, it is an important index of long life and quality of living (Grepin and Bharadwaj, 2015).

Some 827,000 people in low- and middle-income countries die as a result of inadequate water, sanitation, and hygiene each year, representing 60% of total diarrhoeal deaths. Poor sanitation is believed to be the main cause in some 432,000 of these deaths. Diarrhoea remains a major killer but is largely preventable. Better water, sanitation, and hygiene could prevent the deaths of 297,000 children aged under 5 years each year. Open defecation perpetuates a vicious cycle of disease and poverty. The countries where open defection is most widespread have the highest number of deaths of children aged under 5 years as well as the highest levels of malnutrition and poverty, and big disparities of wealth (WHO, 2019)

According to Osibajo (2017), the demographic dividend represents the potential for economic growth that may result from changes in the age structure of the population, particularly when the proportion of the working-age population (15-64) exceeds the proportion of the non-working-age population (14-year-old and 65-old). Nigeria's Federal Government, through the vice president's office, inaugurated Road Map on Demographic Dividend to achieve the country's healthy population and sustainable development. The Vice President–Professor Osibajo believed that appropriate sectors needed to ensure collective efforts and synergy in policy, program and strategic implementation. The federal government of Nigeria urged states and local governments to purchase the multi-sectoral method to guarantee effective and efficient investment by youth across the country. He said, with a total fertility rate in the country of approximately 5.5 children per woman and a youthful age structure of approximately half of the population under the age of 35, and got a great opportunity at this time. Implication of demographic possibilities for the development of our country may have implications that are too severe to be overlooked. Nigeria needs to take advantage of its people's opportunities.

In recent years, growing population has become a key issue of concern to Nigerian and policy makers alike. This is because, rising population in terms of its composition and size, has far-reaching implication for citizens' quality of life. As Odusina (2011) observes, population is a major asset of the developing countries, as resource for economic growth and development, and is also the prime beneficiary of development. It often constitutes the bulk of the producers of goods and services as well as the major consumers of the goods and services. However, the impact of population on development depends not only on the absolute size but also on its quality and implications. Obviously, Nigeria's population is large with appropriately 194 million people (United Nations, 2017). Her population is also about 3% of the world population with a population growth rate of about 2.62% annually alongside with low GDP growth rate of -1.54% (during economic recession) respectively in 2016 (World Bank, 2017). This implies that the current population growth rate in Nigeria exceed the GDP growth rate. With rising population, it become increasingly important to also increase health financing and infrastructure; however, the total health financing (percentage of GDP) is 3.67% in 2016 which is low compare to health spending (% of GDP) of 4.32% and 4.47% in 2004 and 2007 respectively (World Bank, 2017). Consequently, the average life expectancy at birth in Nigeria is merely 53 years in recent years, while it is above 80 years for countries like France, Japan, Singapore, and Hong Kong. For Ghana and Niger, their average life expectancies were 64 and 61 years respectively in 2015 (World Bank, 2017). All these perhaps explain why Nigeria was far from reaching the health-related targets of the recent past Millennium Development Goals (WHO, 2015). Another worrisome issue is the high prevalence of malaria, cholera, acute hepatitis E, stroke, hypertension, typhoid, and all forms of cancer that often constraint longevity (WHO, 2017). Having identified transmission mechanism through various diseases and ailments as well as high growth of unproductive population this may likely explained why Nigeria could not meet up with related targets of MDGs. This study attempted to investigate the impacts of population dynamics (such as population growth, percentage access to basic sanitation, total labour force participation rate and birth rate) and economic factors (such as gross saving) on health in Nigeria (proxy by life expectancy at birth) from 1980 to 2018.

The broad objective of this study investigates the impact of population dynamics on health in Nigeria. Specifically, the study focused on the following.

i. Examine the effect of population growth on health (proxy by life expectancy) in Nigeria.
ii. Identify the relationship between percentage access to basic sanitation and health(proxy by life expectancy)in Nigeria.
iii. Investigate the impact of total labour force participation rate on health (proxy by life expectancy) in Nigeria.
iv. Determine the effect of birth rate on health (proxy by life expectancy) in Nigeria.

II. Review of Related Literature

Conceptual Review:

Population growth rate

Population growth rate is an increase in the number of people that reside in a country, state, or city over time. The global population rise from 2.5 billion to 5.7 billion people between 1950 and 1995, and presently the statistics is nearly 7.6 billion in 2017 up from 7.4 billion in 2015; the figure is also expected to grow to 9.8 billion people by 2050 (United Nations, 2017).

Life expectancy at birth

For longevity or life expectancy (LEB), which refers to the average number of years an infant is expected to live if mortality patterns at the time of birth remains constant in the future (World Bank, 2016). It is the average-period that a person is expected to live as determined taking account of current economic situation. This also reflects the overall mortality level of a population, and summarizes the mortality pattern that prevails across all age groups (WHO, 2006). It also indicates the number of years an infant would live provided the patterns of mortality continues at the time of birth were to stay the same throughout his life. Hence, it is an important index of long life and quality of living (Grepin and Bharadwaj, 2015).Life expectancy at birth is one of the most frequently used health status indicators. Gains in life expectancy at birth can be attributed to a number of factors, including rising living standards, improved lifestyle and better education, as well as greater access to quality health services. This indicator is presented as a total and per gender and is measured in years. Life expectancy at age 65 years old is the average number of years that a person at that age can be expected to live, assuming that age-specific mortality levels remain constant. However, the actual age-specific death rate of any particular birth cohort cannot be known in advance. If rates are falling, as has been the case over the past decades in OECD countries, actual life spans will be higher than life expectancy calculated using current death rates. The methodology used to calculate life expectancy can vary slightly between countries. This can change a country's estimates by a fraction of a year. This indicator is presented by gender and is measured in years (OECD, 2019).

Access to improved sanitation

Access to improved sanitationis used to categorize for tracking purposes types or levels of sanitation. This is measured by the proportion of the population utilizing enhanced sanitation equipment – sewer connections, septic system connections, pour-flush latrines, aerated enhanced pit latrine and a slab or protected pit latrine. (WHO, 2015).

Total labour force participation rate

The labor force participation rate is an important metric to use when analyzing employment and unemployment data because it measures the number of people who are actively job-hunting as well as those who are currently employed. It omits institutionalized people (in prisons, nursing homes, or mental hospitals) and members of the military. It includes all other people age 16 or older and compares the proportion of those who are working or seeking work outside the home to those who are neither working nor seeking work outside the home.Short- and long-term economic trends can influence the labor force participation rate. In the long run, industrialization and the accumulation of wealth can have an impact.Industrialization tends to increase participation by creating employment opportunities. High levels of accumulated wealth can reduce participation because wealthier people simply have less need to work for a living. In the short term, business cycles and unemployment rates influence the participation rate. During an economic recession, the labor force participation rate tends to fall because many laid-off workers become discouraged and give up looking for jobs. Economic policies such as heavy labor market regulation and generous social benefit programs may also tend to decrease labor force participation (Hayes, 2022).

Birth Rate

The number of children born alive each year per 1,000 population. It is measured by dividing the number of live births by the total population in one year and then multiplying the result by 1000 (Todaro and Smith, 2011).

Theoretical review:

Grossman (1972) developed a model of demand for 'good health' where health is treated as a durable capital stock. 'Healthy days' are produced from the health stock from which utility is gained directly, as it allows for the enjoyment of good health (consumption commodity), and indirectly as it allows time to be spent on other market and non-market activities (investment commodity). Individuals are assumed to be utility maximizers and Grossman imposes two constraints: First, a time constraint that states time in a given period has to be allocated to consumption, investment or the generation of wages. An increase in sick days results in a reduction in the time available for these activities. Second, an income constraint to reflect the opportunity cost of time spent on consumption or investment rather than the generation of wages is placed on the maximization problem. It is assumed that individuals are born with a given level of health stock that depreciates with age. This depreciation can be offset by investment activities, but when the stock reaches a critical level death occurs. Grossman, given that the marginal benefit accrued by consumption and investment activities are taken as additive, develops a pure consumption model and a pure investment model by assuming the marginal cost to be constant. Thus, the marginal benefit of the investment and consumption model is separated and equated to the shadow price of health as an additive function of the interest rate and rate of health depreciation (given $\delta MC=0$). This allows for empirical evaluation of the three key predictions that emanate from the investment model. First, an increase in the depreciation rate, which is positively correlated with age, would reduce the demand for health. The reason for this is that as the cost of producing healthy days increase; the marginal cost of investment becomes greater than the marginal benefits. Graphically, the perfectly elastic supply curve shifts upwards and intersect the MEC at a lower level of health stock. Second, an increase in wages would have an indeterminate effect on the quantity of health demanded. As wages increase, there is an increase in the marginal productivity of health as more healthy days are available to earn higher wages creating an incentive to invest in health and demand a higher health stock. However, the shadow price of investment is partly a function of the wage rate.

Empirical Review

Popoola (2018) studied the effect of population growth on Nigeria's average life expectancy and took into account healthy people's particular position in economic development and other control variables not considered in prior studies. He used time series data from 1986 to 2015 for country-specific regression and Granger Causality testing. Results showed that growing population growth has a positive effect on life expectancy; but a 1 percent drop in fertility rate and a 65-and-above dependency ratio could favorably stimulate a longevity enhancement of 5.84 and 81.5 in Nigeria, respectively. In addition, the granger causality test demonstrates that population growth could granger at least 10 percent significantly induced low life expectancy in Nigeria. Consequently, the findings advocate reinforcing efforts to reduce both the fertility rate and the age of 65 and above, with priority being given to the welfare of ages 65 and above in Nigeria.

Hirota (2016), investigated the effects of declining childhood mortality during different periods on human capital accumulation and economic development, using Azarnert's basic framework by dividing childhood into three periods: early childhood (pre-school enrolment period), school age (school enrolment period), and late childhood (a post-school enrollment period)—and assume a constant mortality rate for each period. The result revealed that the decline in mortality after school age promotes accumulation of human capital and economic development. Declining mortality after early childhood hinders accumulation of human capital and economic development, but after late childhood has no effect on the same.

Dogrul (2015), investigated the effect of health on labour force participation in Turkey, applied a two-stage estimation technique for cross-sectional data and found that health status affects labour force participation for all age-gender groups positively and significantly. He also noted on the reverse that participation in the labour force had a significant positive effect on younger men's health and a significant negative impact on older women's health.

Nwosu and Woolard (2015), using bivariate probit and instrumental variables (IV) models on a cross-sectional data to demonstrate the exogeneity of self-assessed health in South Africa's labour force involvement. They found a positive and significant association for both males and females, where the effect was more pronounced among males, between better health and participation in the labour force.

Miljkovie and Glazyrina (2015), examined the influence of socio-economic policy on the overall fertility rate in Russia using a fixed-effect econometric model, analyzed the early / initial effect of changes in social policy, namely the adoption of the Federal Law of RF No. 256-FZ of 12.29.2006, "state support for families with children on additional measures, "on the total fertility rate in Russia. The authors confirmed that Russian total fertility rate was positively influenced by the introduction of Federal Law. The impact of the policy was small in size and the population was unlikely to reproduce fully. As control variables, several other socio-economic and demographic variables have been included in the model. The result indicated that the significant impact of urban and rural unemployment, emigration and death rates on fertility rates suggests that economic policies aimed at creating more jobs in Russia will have a greater positive impact, By increasing per capita income and lowering young people's emigration rates at the peak of their reproductive age, overall fertility rates compared to existing policies. Similarly, major health reforms are aimed at reducing very high mortality rates among the reproductive age population.

Fagbamigbe and Adebowale (2014)used non-linear model to identify determinants of fertility and predict fertility using the characteristics of women's background. Nigeria Demography and Health Survey data set was used in 2008, consisting of 33,385 women with 31.4 percent from urban areas. Fertility was measured using children ever born (CEB) and incorporated into multi-factor additive Poisson regression models. The result revealed that mean age of respondents was 28.64±9.59years, mean CEB 3.13±3.07, but higher among rural women than urban women (3.42±3.16 vs. 2.53±2.79). Women aged 20-24 years were about twice as likely as women aged 15-19 years to have higher CEBs (IRR=2,06, 95% CI: 1,95-2,18). The minimal deviance model was selected and used by the woman to predict CEB.

Onisanwa (2014), considered the impact of health on Nigeria's economic growth, applying techniques of co-integration and causality to Granger on a data set of time series. The findings showed that GDP is positively influenced in the long run by health indicators (i.e. life expectancy and fertility rate), and in return health indicators cause GDP per capita that implies a long-term health impact.

Cervellati and Sunde (2009), using econometrics regression method, examined the causal effect of life expectancy on economic growth by explicitly taking into account the role of demographic transition. The study presented a simple theory of economic and demographic transition where the decision on education and fertility depends on the life expectancy of individuals. The theory predicts that improvements in life expectancy will primarily increase the population prior to the demographic transition. Life expectancy improvements, however, reduce population growth and foster accumulation of human capital after the demographic transition has begun. This implies that before and after the demographic transition, the effect of life expectancy on population, human capital and per capita income is not the same. In addition, the transition to sustained income growth ultimately triggers a sufficiently high life expectancy. In the context of the epidemiological revolution, we provide evidence to support these predictions using data on exogenous mortality reductions.

Akram, Padda, and Khan (2008) used co-integration and error correction techniques on Pakistan's time series data for the period 1972-2006 to investigate the impacts of various health indicators on economic growth in Pakistan. The study finds per capita GDP is positively influenced by long-term health indicators and per capita GDP is caused by health indicators. The health indicators, however, do not significantly impact per capita GDP in the short run. It revealed the long-term impact of health indicators on economic growth. It also suggests that health impact is only a long-term phenomenon and there is no significant relationship between health variables and economic growth in the short-term. The study's main policy implication is that if we want high per capita income levels, we can achieve it by increasing and improving health capital stocks, especially when current stocks are at lower ends. In addition, the study also highlights the rather diminishing role that public health spending plays in determining per capita GDP.

Caiand Kalb (2007) investigated the relationship between health and labour participation in Australia using simultaneous equation panel model, full information maximum probability criterion and two stage minimum squares to observe the relationship between self-assessed health and the participation of labour force. Using HILDA data, health has been observed to have a positive and significant effect on the participation of both men and women in the labour force. However, considering the reverse effect of labour force participation on health status, a negative effect was observed for males suggesting that, the commonly held view that men outside the labour force may not be true to justify their non-participation in overestimating their health problems. For women, the effect was positive because of the way women select themselves in the labour force and the way they choose jobs.

Acemoglu and Johnson (2006), based on the international epidemiological transition, the wave of international health innovations and improvements that began in the 1940s, investigated the effect of increasing life expectancy on economic growth. Prior to the 1940s, the researchers collected estimates of disease mortality from the League of Nations and national sources of public health. They eventually built a tool for life expectancy changes, referred to as predicted mortality, based on pre-intervention mortality distribution from various diseases around the world and global intervention dates. The results revealed that predicted mortality has a large and robust effect on changes in life expectancy starting in 1940, but no effect on changes in life expectancy before the interventions.

The measured changes in life expectancy have a major impact on the population; a 1% increase in life expectancy leads to a population increase of about 1.5%. However, life expectancy has a much smaller impact on total GDP initially as well as over a 40-year horizon. There is no evidence subsequently that the large exogenous increase in life expectancy has resulted in a substantial increase in economic growth per capita. These results confirm that global efforts to combat poor health conditions in less developed countries can be highly effective, but also cast doubt on claims that the root cause of some nations' poverty is unfavorable health conditions. These results confirm that global efforts to combat poor health conditions in less developed countries can be highly effective, but also cast doubt on claims that the root cause of some nations' poverty is unfavorable health conditions. The effect of health on the participation of men and women in the labour force is stronger if wages are not controlled for. They also observed a negative health-wage correlation. Since 1960, the effect of income on the family decision to have children has been studied intensively. Household propensity to have children has traditionally been treated as a problem of a family utility function being limited to maximization.

Alemu (2017) empirically examined the extent to which improved sanitation explains the observed differences in infant mortality under 5 years of age across African countries.The study covered a panel of 33 countries from north, south, east, west and central Africa for the years 1994–2013.The study first conducted Durbin–Wu–Hausman specification test and then used fixed effect model. In addition, Praison–Winsten regression with corrected heteroscedasticity was employed to verify the consistency of the results that were revealed in using fixed effect estimation method.The study revealed that a 1% increase in access to improved sanitation would reduce infant mortality by a rate of about two infant deaths per 1000 live births. Also, the study confirmed that a significant decline in infant mortality rate was highly linked to improvements in education, health and sustainable economic growth.

Bloom, Canning, and Graham (2003)added health and longevity to a standard model of life-cycle saving and show that, under plausible assumptions, increases in life expectancy lead to higher savings rates at every age, even when retirement is endogenous. In a stationary population these higher savings rates are offset by increased old age dependency, but during the disequilibrium phase, when longevity is rising, the effect on aggregate savings rates can be substantial. They found empirical support for this effect using a cross-country panel of national savings rates.

Zhang and Zhang (2005) constructed a simple growth model where agents with uncertain survival choose schooling time, life-cycle consumption and the number of children. They showed that rising longevity reduces fertility but raises saving, schooling time and the growth rate at a diminishing rate. Cross-section analyses using data from 76 countries support these propositions: life expectancy has a significant positive effect on the saving rate, secondary school enrollment and growth but a significant negative effect on fertility. Through sensitivity analyses, the effect on the saving rate is inconclusive, while the effects on the other variables are robust and consistent. These estimated effects are decreasing in life expectancy.

III. Methodology

Research Design

The study adopted the descriptive survey research design. This involves the collection of data for the purpose of describing and interpreting the existing situation. The data reflected the impact of population dynamics on health in Nigeria. The proxy for health is life expectation at birth. While population dynamics included as independent variables, among which are: population, percentage access to sanitation, gross saving rate, total labour force participation rate, and birth rate.

Model Specification

The model for this study was specified based Grossman (1972) developed a model of demand for ‘good health’ where health is treated as a durable capital stock. ‘Healthy days’ are produced from the health stock from which utility is gained directly, as it allows for the enjoyment of good health (consumption commodity), and indirectly as it allows time to be spent on other market and non-market activities (investment commodity).Also, the study hinged on the modification of the work of Popoola (2018) who studied the effect of population growth on Nigeria's average life expectancy. The independent variables contain population growth, percentage access to sanitation, gross saving rates, total labourforce participation rates, and birth rates.

Health Model - Functional Form

$$\text{LEXB} = f(\text{P}) \qquad \text{Equation (3.1)}$$

Health Model - Econometric Form

$$\text{LOGLEXB} = f(\text{LOGPOP}, \text{PABS}, \text{GSR}, \text{TLFPR}, \text{BR}, \mu) \qquad \text{Equation (3.2)}$$

$$\text{LEXB} = \beta_0 + \beta_1 \text{LOGPOP} + \beta_2 \text{PABS} + \beta_3 \text{GSR} + \beta_4 \text{TLFPR} + \beta_5 \text{BR} + \mu \qquad \text{Equation (3.3)}$$

$$\text{Apriori Expectation}: \ \beta_1 < 0;\ \beta_2 > 0;\ \beta_3 > 0;\ \beta_4 > 0; \beta_5 > 0$$

$$\text{Null Hypothesis:}\ \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$$

Where, LOGLEXB = Life Expectancy at Birth (proxy for health in %); LOGPOP = log of population (%); PABS = percentage access to basic sanitation (%); GSR= gross saving rate (%) and TLFPR = total labour force participation rate. β_0 is the constant value of life expectancy (proxy for health) when other explanatory variables are equal to zero, $\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 are coefficients of explanatory variables that explain health, while μ is the corresponding error correction or stochastic factor.

Sources of Data

This study employed secondary data from World Development Indicators (WDI) – a publication of World Bank;The Bulletin -Central Bank of Nigeria publication, and Nigerian Bureau of Statistics (NBS).

Estimation Techniques

Unit Root Test conducted as the pre Co-integration test and used to determine the order of integration of a variable that is how many times it has to be differenced or not to become stationary. It is to check for the presence of a unit root in the variable i.e. whether the variable is stationary or not. The null hypothesis is that there is no unit root. This test is carried out using the Augmented Dickey Fuller (ADF) technique of estimation. The rule is that if the ADF test statistic is greater than the 5 percent critical value we accept the null hypothesis i.e. the variable is stationary but if the ADF test statistic is less than the 5 percent critical value i.e. the variable is non-stationary we reject the null hypothesis and go ahead to difference once. If the variable does not become stationary at first difference we difference twice. However it is expected that the variable becomes stationary at first difference. Thus, the relevant estimation techniques were used based on the order of integration of all the variables as obtained through unit root test.

IV. Data Analysis And Interpretation

4.1Test for Correlation among Independent Variables

Table 4.1: Correlation coefficients analysis

	LOGPOP	PABS	GSR	TLFPR	BR	RGFCFG
LOGPOP	1					
PABS	-0.893374	1				
GSR	0.047481	-0.155629	1			
TLFPR	-0.605895	0.479303	-0.270461	1		
BR	-0.979442	0.870246	-0.000943	0.449621	1	
RGFCFG	0.233037	-0.161433	0.086454	-0.413860	-0.173118	1

Source: Author's computation from E-view 10 software

From Table 4.1, the maximum value of correlation coefficient among the independent variables was 0.87 which is less than 0.9 specified by Hair et al (2006) which concluded that correlation below this value is free from multicollinearity. Thus, the foregoing literature qualified the independent variables to be freed from multicollinearity.

4.2 Unit Root Test

Table 4.2: Augmented Dickey-Fuller test

Variables	Levels	1st Difference	2nd Difference	Order of Integration
LOGLEXB	-16.16953*** (-3.562882)	-	-	I (0)
LOGPOP	-4.352210*** (-3.552973)	-	-	I (0)
PABS	-2.414568 (-3.540328)	-0.922353 (3.540328)	-13.84698*** (-3.540328)	I (2)
GSR	-5.577696*** (-3.533083)	-	-	I (0)
TLFPR	-1.629786 (-3.536601)	-2.031650 (3.536601)	-6.209010*** (3.540328)	I (2)
BR	-4.030681*** (-3.568379)	-	-	I (0)
RGFCFG	--1.528356 (-3.540328)	-10.47230*** (3.540328)		I (1)

Source: Author's computation from E-view 10 software (*** represent 1% probability level, while values in bracket ( ) represent t-statistic at 5% level

Table 4.2 showed the unit root computations for variables involved in this study, where log life expectancy at birth (LOGLEXB), log population (LOGPOP), gross saving rate (GSR) and birth rate (BR) stationary at levels, real gross fixed capital formation growth (RGFCFG) stabilized at first difference, while percentage access to basic sanitation and total labour force participation rate (TLFPR) stabilized at second difference. Thus, the foregoing unit root results suggest the use ordinary least square method for the model estimation.

4.3 Johansen Co-integration Test

Given the non-stationarity of some of the variables, Johansen co-integration test was carried out for variables in the study.

Table 4.3: Cointegration rank test (trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.961751	314.2392	150.5585	0.0000
At most 1 *	0.869092	206.5393	117.7082	0.0000
At most 2 *	0.752925	139.4418	88.80380	0.0000
At most 3 *	0.656293	93.30581	63.87610	0.0000
At most 4 *	0.611490	58.06295	42.91525	0.0008
At most 5 *	0.404491	26.86351	25.87211	0.0376
At most 6	0.255995	9.758356	12.51798	0.1386

Trace test indicates 6 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's computation from E-view 10 software

Table 4.4: Cointegration rank test (eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.961751	107.6999	50.59985	0.0000
At most 1 *	0.869092	67.09749	44.49720	0.0000
At most 2 *	0.752925	46.13604	38.33101	0.0052
At most 3 *	0.656293	35.24286	32.11832	0.0200
At most 4 *	0.611490	31.19944	25.82321	0.0088
At most 5	0.404491	17.10516	19.38704	0.1041
At most 6	0.255995	9.758356	12.51798	0.1386

Max-eigenvalue test indicates 5 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's computation from E-view 10 software

The results of the cointegration tests are presented in Tables 4.3 and 4.4 respectively for variables in the study. The trace and maximum eigenvalues test statistics indicate that the hypothesis of no cointegration among the variables is rejected at the 5% significance level. From the result, Trace test indicates 6 cointegrating equations at the 0.05 level. Also, maximum engenvalue statistics indicates 5 cointegrating equations. The existence of a stable long-run equilibrium relationship among the variables necessitates the use of the Error Correction Mechanism (ECM) for selected model. The Error Correction Mechanism will show the speed of adjustment and the average time it will take for short-run distortions in the relationship to be corrected. The speed of adjustment stood at 0.32 with appropriate negative and level of probability (See appendix 1 and 2 for both over paramatization and error correction mechanism respectively).

4.5 Ordinary Least Square Estimation Result

Table 4.5: Regression result with dependent variable – life expectancy

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.630749	0.979741	2.685146	0.0117
LOGPOP	-0.124013	0.128900	-0.962086	0.3437
D(PABS,2)	0.106144	0.011288	9.403064	0.0000
GSR	0.008907	0.002636	3.379239	0.0020
D(TLFPR,2)	-0.022177	0.034924	-0.634995	0.5302
BR	-0.001233	0.007658	-0.161000	0.8732
R-squared	0.818602	Mean dependent var		1.942862
Adjusted R-squared	0.788369	S.D. dependent var		0.038905
S.E. of regression	0.017898	Akaike info criterion		-5.057298
Sum squared resid	0.009610	Schwarz criterion		-4.793378
Log likelihood	97.03136	Hannan-Quinn criter.		-4.965183
F-statistic	27.07647	Durbin-Watson stat		1.855585
Prob(F-statistic)	0.000000			

Source: Author's computation from E-view 10 software

Table 4.5 shows the long run relationship among the variables. The R-square is 0.818602 and adjusted R –square is 0.788369, the foregoing results showed that 79% of the explanatory variables explain the dependent variable – LOGLEXB (proxy for health). While the F-statistic value is 22.45066 at 1 % level of probability. The Durbin-Watson value is 1.855585 (approximately 2.0), which showed that the equation is not spurious and devoid of serial correlation.

Population

The coefficient of population is (-0.124013 and is not significant. Thus 100 increase in population leads on average to 12% decrease in life expectancy. Thus there exists a negative relationship between population and life expectancy within the period of study. The foregoing result implies that increase in population reduce life expectancy in Nigeria. This may arise as a result of population burden especially from high number of dependents on working population. This suggests that Nigeria population should be improved through job creation for the dependent youths.

Percentage Access to Basic Sanitation (PABS)

The coefficient of percentage access to basic sanitation 0.106144 is significant at 1% level of probability. Thus 100% increase in percentage access to basic sanitation leads on average to 11% increases in life expectancy. There exists a positive relationship between percentage access to basic sanitation and life expectancy within the period of study. The forgoing result signifies that increase percentage access to basic sanitation increases life expectancy in Nigeria. This may arise owing to the fact that access to basic sanitation reduces likely bacterial infections that may be encountered by Nigerians through unhealthy sanitation such as open defecation.

Gross Saving Rate (GSR)

The coefficient of gross saving rate is 0.008907, significant at 1% level of probability. Thus 100% increases gross saving rate leads on average to 0.9% increases in life expectancy. Thus, there exists a positive relationship between gross saving rate and life expectancy within the period of study. The forgoing result indicates that increase rate of gross saving increases life expectancy in Nigeria. This suggests that savings contribute positively to improved life expectancy among retirees and working population, the higher the retirement and bank savings the higher the life expectancy in Nigeria. The foregoing guaranteed continuous consumption, increases output and investment which can cater for improved health at old age, hence increase in life expectancy.

Total Labour Force Participation Rate

The coefficient of total labour force participation rate is (-0.022177) and not significant. Thus, 100% increases in total labour force participation rate leads on average to 2.2% decrease in life expectancy. There exists a negative relationship between total labour force participation rate and life expectancy within the period of study. The forgoing result indicates that total labour force participation rate decreases life expectancy in Nigeria. This suggests that the more the numbers of people participated in labour force in terms of employment, the lower the life expectancy which could be traced to lack of stress management among working population. Many working population are busy on their working stations to the extent that they do not have time for medical check-up, thereby any unattended health challenges can lead to untimely death, which eventually reduced their life expectancy.

Birth Rate

The coefficient of birth rate is (-0.01233) and not significant. Thus, 100% increase in birth rate leads on average to 1.2% decrease in life expectancy. There exists a negative relationship between birth rate and life expectancy within the period of study. The foregoing result indicates that increase in birth rate reduced life expectancy in Nigeria. This suggests that pregnant women need to be attentive to all medical advises given during antenatal, so as to reduce maternal mortality and improve life expectancy. Also, there is urgent need for Nigeria to comply with the standard reproductive health programme for women as directed by world health organisation.

4.6 Diagnostic Test:

Table 4.6: Correlogram of residuals

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.*| . |	.*| . |	1	-0.192	-0.192	1.4429	0.230
.*| . |	.*| . |	2	-0.078	-0.119	1.6874	0.430
. |*. |	. | . |	3	0.100	0.063	2.1009	0.552
.*| . |	.*| . |	4	-0.165	-0.148	3.2606	0.515
.*| . |	.*| . |	5	-0.077	-0.133	3.5201	0.620
.*| . |	**| . |	6	-0.174	-0.277	4.9086	0.556
. | . |	. | . |	7	0.066	-0.042	5.1156	0.646
. | . |	. | . |	8	0.005	-0.061	5.1168	0.745
. | . |	. | . |	9	0.066	0.052	5.3358	0.804
.*| . |	**| . |	10	-0.148	-0.263	6.4848	0.773
. | . |	.*| . |	11	0.052	-0.091	6.6352	0.828
. | . |	**| . |	12	-0.046	-0.214	6.7540	0.873
. | . |	. | . |	13	0.052	0.057	6.9120	0.907
. |*. |	. |*. |	14	0.150	0.086	8.3180	0.872
.*| . |	. | . |	15	-0.100	-0.052	8.9681	0.879
. |** |	. |*. |	16	0.269	0.159	13.927	0.604

Source: Author's computation from E-view 10 software

Table 4.6 shows the correlograms of Q statistic which can be used to check autoregressive conditional heteroskedasticity (ARCH) in the residuals. We confirmed that in the estimated equation/model there is ARCH in the residuals, the autocorrelations and partial autocorrelations are not zero at all lags and the Q-statistics are significant.

Table 4.7: Correlogram of square residuals

<table>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>. | . |</td><td>. | . |</td><td>1</td><td>0.068</td><td>0.068</td><td>0.1795</td><td>0.672</td></tr>
<tr><td>. |*. |</td><td>. |*. |</td><td>2</td><td>0.206</td><td>0.202</td><td>1.8833</td><td>0.390</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>3</td><td>0.024</td><td>-0.001</td><td>1.9075</td><td>0.592</td></tr>
<tr><td>. |*. |</td><td>. | . |</td><td>4</td><td>0.077</td><td>0.036</td><td>2.1633</td><td>0.706</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>5</td><td>0.018</td><td>0.008</td><td>2.1778</td><td>0.824</td></tr>
<tr><td>. | . |</td><td>.*| . |</td><td>6</td><td>-0.043</td><td>-0.070</td><td>2.2635</td><td>0.894</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>7</td><td>-0.059</td><td>-0.062</td><td>2.4271</td><td>0.932</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>8</td><td>-0.091</td><td>-0.070</td><td>2.8349</td><td>0.944</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>9</td><td>-0.035</td><td>-0.004</td><td>2.8957</td><td>0.968</td></tr>
<tr><td>.*| . |</td><td>. | . |</td><td>10</td><td>-0.075</td><td>-0.036</td><td>3.1937</td><td>0.976</td></tr>
<tr><td>.*| . |</td><td>. | . |</td><td>11</td><td>-0.074</td><td>-0.054</td><td>3.4935</td><td>0.982</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>12</td><td>-0.037</td><td>0.000</td><td>3.5717</td><td>0.990</td></tr>
<tr><td>.*| . |</td><td>.*| . |</td><td>13</td><td>-0.089</td><td>-0.067</td><td>4.0431</td><td>0.991</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>14</td><td>-0.026</td><td>-0.017</td><td>4.0867</td><td>0.995</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>15</td><td>0.002</td><td>0.034</td><td>4.0868</td><td>0.997</td></tr>
<tr><td>. |** |</td><td>. |** |</td><td>16</td><td>0.281</td><td>0.300</td><td>9.4925</td><td>0.892</td></tr>
</table>

Source: Author's computation from E-view 10 software

Table 4.7 indicates the correlograms of the squared residuals which can be used to check autoregressive conditional heteroskedasticity (ARCH) in the residuals. We confirmed that in the estimated equation/model there is ARCH in the residuals, the autocorrelations and partial autocorrelations are not zero at all lags and the Q-statistics are significant.

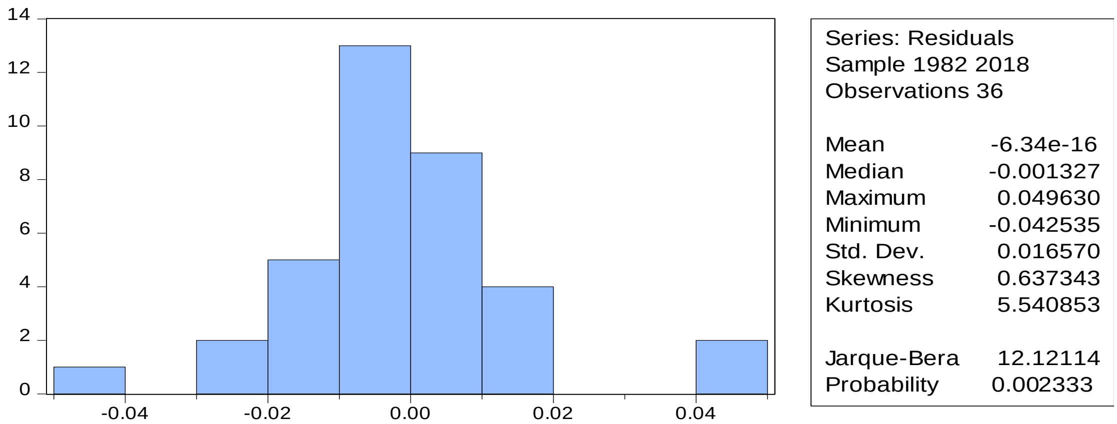

Figure 4.1: Histogram for the model
Source: Author's computation from E-view 10 Software

Figure 4.1 displays a histogram and descriptive statistics of the residuals, including the Jarque-Bera statistic for testing statistic for testing normality. If the residuals and normally distributed, the histogram should be bell-shaped and the Jarque-Bera statistic should not be significant. Thus, the residuals of this model are bell shaped and normally distributed since the probability of Jarque-Bera statistic is not significant.

Table 4.8: Breusch-Godfrey serial correlation LM test for model 3

F-statistic	2.452672	Prob. F(2,28)	0.1043
Obs*R-squared	5.366677	Prob. Chi-Square(2)	0.0683

Source: Author's computation from E-view 10 Software

Table 4.8 shows that there is no serial correlation among the variables in model 1 since the probability value of F-statistics is considerably in excess of 0.05 (i.e. 5%).

Table 4.9: Heteroskedasticity Test (Breusch-Pagan-Godfrey)

F-statistic	7.883422	Prob. F(5,30)	0.0001
Obs*R-squared	20.44188	Prob. Chi-Square(5)	0.0010
Scaled explained SS	32.23040	Prob. Chi-Square(5)	0.0000

Source: Author's computation from E-view 10 Software

Table 4.9 shows the heteroskedasticity test for model 1, which indicates that there is evidence of the presence of heteroscedacity among the variables since the probability value of F-statistics is considerably in below 0.05 (i.e. 5%).

Stability test – used cusum test after recursive estimate

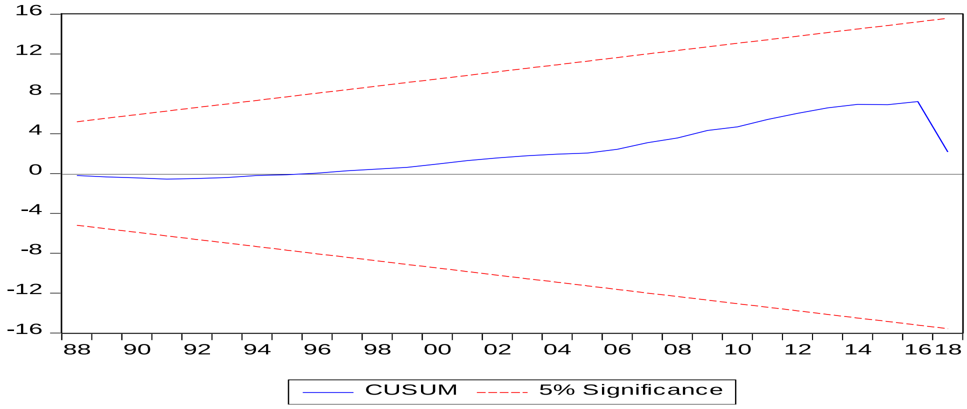

Fig 4.2: Cusum for the model

Source: Author's Computation from E-View 10 Software

It can be seen from the above view that the plot of cusum of square stays within the critical 5% bounds that confirms the long-run relationships among variables and thus showed the stability of coefficients.

4.7 Hypothesis Testing and Interpretation

Having done all the diagnostic tests and confirmed the stability of the coefficients of the variables in the long run equation, we therefore attempted to test the stated hypothesis as follows:

To ascertain if the core population variables have significant effect on life expectancy (proxy for health). The decision rule is that we reject the null hypothesis if t-statistic (computed value) is greater than the critical value (i.e. table value); otherwise we accept the null hypothesis. Therefore, from the estimated result for long run form shown in Table 4.5, the t-statistic for population in absolute term is 0.962086, less than critical value 2.021 (i.e. area with df=31; p=0.025). Thus, we accept the null hypothesis (H_0: $\beta_1 = 0$) and concluded that population has negative relationship but insignificant effect on life expectancy in Nigeria. The lower the population the better the life expectancy of working population provided the foregoing action reduced numbers of dependents.

The t-statistic for percentage access to basic sanitation is 9.403064, greater than critical value 2.021. Thus, we reject the null hypothesis (H_0: $\beta_2 = 0$) and concluded that percentage access to basic sanitation has significant effect on life expectancy. Therefore, the foregoing result implied that percentage access to basic sanitation should be given priority in Nigeria so as to continuously improve the health status through standard toilets and increase life expectancy in Nigeria.

The t-statistic for gross saving rate is 3.379239, and greater than critical value 2.021. Thus, we reject the null hypothesis (H_0:$\beta_3 = 0$) and concluded rate of gross saving has significant effect on life expectancy within the period of study. This suggests that increase in saving among working population can serve as a competitive advantage during retirement, thus the foregoing shall enhanced payment for consumption and health bill hence increased life expectancy after retirement.

The t-statistic for total labour force participation rate in absolute term is 0.634995 and less than critical value 2.021. Thus, we accept the null hypothesis (H_0: $\beta_4 = 0$) and concluded that total labour force participation rate has no significant effect on life expectancy in Nigeria within the period of study. This implies that total labour force participation rate has negative relationship but no significant effect on life expectancy in Nigeria. This reflected that the quantum of labour force that pay less attention to their health are insignificant to reduce life expectancy in Nigeria, the foregoing showed that other factors are responsible for reduced life expectancy among labour force.

The t-statistic for total birth rate in absolute term is 0.161000 and less than critical value 2.021. Thus, we accept the null hypothesis (H_0: $\beta_5 = 0$) and concluded that birth rate has no significant effect on life expectancy in Nigeria within the period of study. This implies that birth rate has negative relationship but no significant effect on life expectancy in Nigeria. This reflected that increase in birth rate may cause increase in maternal mortality if the mother at their reproductive age do not pay necessary attention to medical advises at both antenatal and postnatal stages, thus this reduced life expectancy of the mother. This result is insignificant because there are other factors other than birth rate - such as bacterial and virus infections that may cause maternal mortality and reduce life expectancy.

Discussion of Findings with Related Literatures

The current study established a negative and insignificant relationship between population and life expectancy within the period of study. The foregoing finding is contrary to the work of Popoola (2018) that showed that growing population growth has a positive and significant effect on life expectancy.

There exists a positive and significant relationship between percentage access to basic sanitation and life expectancy within the period. Thus, the foregoing result supports the work of Alemu (2017), which revealed that a 1% increase in access to improved sanitation would reduce infant mortality by a rate of about two infant deaths per 1000 live births.

There exists a positive and significant relationship between gross saving rate and life expectancy within the period of study. The foregoing result agreed with the work of Bloom, Canning and Graham (2003) which showed that, under plausible assumptions, increases in life expectancy lead to higher savings rates at every age, even when retirement is endogenous. Also the work of Zhang and Zhang (2005) supported the foregoing finding by showed that rising longevity raises saving.

There exists a negative and insignificant relationship between total labour force participation rate and life expectancy within the period of study. The foregoing result disagreed with the finding of Dogrul (2015) that found a positive and significant association for both males and females, where the effect was more pronounced among males, between better health and participation in the labour force. While the current finding agreed with the work of Caiand Kalb (2007) which stated that a negative effect was observed for males suggesting that, the commonly held view that men outside the labour force may not be true to justify their non-participation in overestimating their health problems.

There exists a negative and insignificant relationship between birth rate and life expectancy within the period of study. Thus the foregoing result agreed with the work of Zhang and Zhang (2005) which showed that rising longevity reduces fertility.

V. Summary, Conclusion And Recommendations

Summary

In this study we found the following influences of population dynamics on health (using life expectancy at birth as a proxy):

There exists a long run relationship among the variables of the study. 79% of the explanatory variables explained the dependent variables. There exists a stable model of the study with F-statistic value at 1% level of probability. The established model of the study was devoid of multi-collinearity with the value of Durbin Watson stood at 1.855585 (approximately 2).

There exists a negative and insignificant relationship between population and life expectancy within the period of study.

There exists a positive and significant relationship between percentage access to basic sanitation and life expectancy within the period of study.

There exists a positive and significant relationship between gross saving rate and life expectancy within the period of study.

There exists a negative and insignificant relationship between total labour force participation rate and life expectancy within the period of study.

There exists a negative and insignificant relationship between birth rate and life expectancy within the period of study.

Conclusion

This study attempted to investigate the impact of population dynamics on health in Nigeria. The study examined the effect of population growth on health (proxy by life expectancy) in Nigeria and found that there exists a negative and insignificant relationship between population and life expectancy within the period of study; identified the relationship between percentage access to basic sanitation and health (proxy by life expectancy)in Nigeria and found that there exists a positive and significant relationship between percentage access to basic sanitation and life expectancy within the period of study; investigated the impact of total labour force participation rate on health (proxy by life expectancy)in Nigeria and found that there exists a negative and insignificant relationship between total labour force participation rate and life expectancy within the period of study; and finally determined the effect of birth rate on health (proxy by life expectancy) in Nigeria and found that there exists a negative and insignificant relationship between birth rate and life expectancy within the period of study.

Recommendations

The following recommendations are therefore derived from the results obtained from the study.

i. That a negative and insignificant relationship between population and life expectancy within the period of study signify that government has to manage the population of its citizens in such a way that it will improve their life expectancy – a measure of good health.
ii. That a positive and significant relationship between percentage access to basic sanitation and life expectancy within the period of study indicate that assurance of access to improved sanitations programs such as provision of modern toilets, and provision of pipe borne water by government which will enhance increase life expectancy of the citizens.
iii. That a positive and significant relationship between gross saving rate and life expectancy within the period of study should form the basis for government to drive for improved savings among the citizens for the purpose of increase life expectancy and good health of the populace.
iv. That a negative and insignificant relationship between total labour force participation rate and life expectancy within the period of study indicates that government should embark on improved health of the citizens in order to enhance total labour force participation rate.= for the purpose of improved standard of living and increase in output.
v. That a negative and insignificant relationship between birth rate and life expectancy within the period of study adjudge that government should improve on maternal productivity programmes so as to enhance increase life expectancy at birth.

References

[1]. Acemoglu D. and Johnson S. (2006). Disease and development: The effect of life expectancy on economic growth. National Bureau of Economic Research, Cambridge, Working Paper 12269: 1-88.

[2]. Akram N., Padda, I. and Khan M.(2008). The long term impact of health on economic growth in Pakistan.The Pakistan Development Review, 47(4): 487-500.

[3]. Alemu A. M. (2017). To what extent does access to improved sanitation explain the observed differences in infant mortality in Africa?African Journal of Primary Health Care andFamily Medicine, 9(1),e1–e9. https://doi.org/10.4102/phcfm.v9i1.1370

[4]. Bloom, D. E., Canning, D., and Graham, B. (2003).longevity and life-cycle savings. The Scandinavian Journal of Economics, 105(3), 319–338. http://www.jstor.org/stable/3440944

[5]. Cai, L. and Kalb, G. (2007). Health status and labour force status of older working-age Australian Journal of Labour Economics, 10(4): 227 – 252.

[6]. Cervellati, M. and Sunde U. (2009). Life Expectancy and Economic Growth: The Role of the Demographic Transition. IZA Discussion Paper No. 4160, 51p.

[7]. Dogrul, H. G. (2015). The effects of health on labour force participation: evidence from Turkey. International Journal of Economics and Finance, 7(8): 168-181.

[8]. Miljkovie, D. and Glazyrina, A. (2015). The impact of socio-economic policy on total fertility rate in Russia, Journal of Policy Modeling, Elsevier, 37(6): 961-973.

[9]. Nwosu, and Woolard, I.(2015). Impact of health on labour participation in South Africa, Working Paper 548, Economic Research South Africa, 34p.

[10]. Odusina, K. K. (2011). Implications of rapidly growing Nigerian population: A review of literature. Retrieved from http://www.pdfscholars.com/files

[11]. Onisanwa, I. D. (2014). The Impact of Health on Economic Growth in Nigeria. Journal of Participation in Nigeria' Economic Growth Centre, Discussion Paper 879, Yale. 71p.

[12]. Dogrul, H. G. (2015). The effects of health on labour force participation: evidence from Turkey. International Journal of Economics and Finance, 7(8): 168-181.

[13]. Doris, D. S. (2022). Population of Nigeria 1950-2021. Statista.

[14]. Fagbamigbe A. F., and Adebowale A. S. (2014). Current and predicted fertility using poisson regression model: Evidence from 2008 Nigerian demographic health survey.African Journal of Reproductive Health 18(1):71-83.

[15]. Grepin, K. A. and Bharadwaj, P. (2015). Maternal education and child mortality in Zimbabwe Journal of Health Economics,44, 97-117.

[16]. Grossman, M. (1972).On the concept of health capital and the demand for health.Journal of Political Economy, 80, 223-255.

[17]. Hayes, A. (2022).Labour force participation rate. Investopedia.com/term...(Retrieved 10-2-22.)

[18]. Hirota Y. (2016). The timing of mortality decline and human capital accumulation. Theoretical Economics Letters, Scientific Research Publishing. 4(6): 34-38.OECD (2019).

[19]. Todaro, M. P. and Smith S. C.(2011). Economic Development. Pearson Education limited, England, 801p.

[20]. United Nations Population Statistics (2017). WHO (2015).

[21]. World Bank, (2017).World Development Indicators| World DataBank [WWW Document]. URL http://databank.worldbank.org/data/reports.aspx?source=world-developmentindicators

APPENDIX
APPENDIX 1:

Overparamatizedfor the Model with dependent variable – life expectancy

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.096170	0.119159	9.199238	0.0000
LOGPOP(-1)	0.079712	0.015643	5.095660	0.0000
BR	-0.224328	0.001292	-173.5735	0.0000
BR(-1)	0.686355	0.015224	45.08446	0.0000
BR(-2)	-0.767124	0.031003	-24.74322	0.0000
BR(-3)	0.315057	0.016637	18.93674	0.0000

R-squared	0.999481	Mean dependent var	1.942314
Adjusted R-squared	0.999392	S.D. dependent var	0.039332
S.E. of regression	0.000970	Akaike info criterion	-10.88403
Sum squared resid	2.73E-05	Schwarz criterion	-10.61740
Log likelihood	196.4705	Hannan-Quinn criter.	-10.79199
F-statistic	11177.68	Durbin-Watson stat	1.723100
Prob(F-statistic)	0.000000		

Source: Author's computation from E-view 10 software

APPENDIX 2:

ECM correction mechanism for the model with dependent variable – life expectancy

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.065587	0.119579	8.911178	0.0000
LOGPOP(-1)	0.084588	0.015796	5.355173	0.0000
BR	-0.155324	0.044079	-3.523736	0.0015
BR(-1)	0.488135	0.127298	3.834593	0.0007
BR(-2)	-0.574986	0.126154	-4.557799	0.0001
BR(-3)	0.252283	0.043196	5.840400	0.0000
ECM(-1)	-0.003241	0.013539	0.239386	0.0126

R-squared	0.992201	Mean dependent var	1.948758
Adjusted R-squared	0.990468	S.D. dependent var	0.009840
S.E. of regression	0.000961	Akaike info criterion	-10.87659
Sum squared resid	2.49E-05	Schwarz criterion	-10.56233
Log likelihood	191.9020	Hannan-Quinn criter.	-10.76942
F-statistic	572.5115	Durbin-Watson stat	1.559837
Prob(F-statistic)	0.000000		

Source: Author's computation from E-view 10 software

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