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Macroeconomic and Socio-Demographic Determinants of Longevity in Nigeria

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Abstract

Nigeria is characterized as a country with the lowest life expectancy rate globally. Hence, this study empirically estimated the effect of macroeconomic and socio-demographic characteristics on life expectancy in Nigeria. The study covered a period of 1986 to 2022 and employed Auto-regressive Distributive Lag (ARDL) to model the said effect. Findings revealed that reduction in population growth, domestic and external debts could improve life expectancy in the long-run. Additionally, increase in per capita income and consumption expenditure would improve longevity in Nigeria. The error correction model (ECM) term of –0.2596 demonstrated that a 25% deviation from the long-run equilibrium in longevity is improved annually. Following the results from this investigation, this study recommended that focus should be on strengthening macroeconomic and socio-demographic indicators in Nigeria.

Keywords: Longevity, Macroeconomic Variables, Socio-Demographic Factors, Nigeria

JEL Classification: E24, I15, J21

1. Introduction

There has been growing concern about low longevity, particularly in developing countries over the recent years. This issue is also reinforced by international pressures on nations (Nigeria inclusive) to achieve the SDGs target 3 before 2030 (United Nations, 2018). It is worthy of note that before the 2000s, infectious diseases such as malaria, yellow fever, tuberculosis, pneumonia, cholera, measles, polio and sexually transmitted diseases, were the main causes of human ill-health and deaths, especially in Africa (WHO, 2017). The discovery and effective use of insecticides and control and prevention programmes in the last three decades have contributed significantly to reducing the prevalence of infectious diseases globally. For instance, pneumonia and bronchitis, one of dangerous group of infectious diseases was ranked 4th causes of poor health outcomes in 2000. However, it claimed fewer lives in 2019 (WHO, 2020).

However, from the 1990s onwards, global medical sciences began to emphasize the serious threat and growing trends of low longevity from non-communicable diseases (NCDs)

particularly in low and middle-income countries (WHO, 2017). Chronic illness from diabetes alone killed 1.6 million people globally in 2016, but less than 1 million death was recorded from diabetes was recorded in 2000 (WHO, 2020). Diabetes claimed nearly 80% lives between 2000 and 2021, and accounted for 6.7 million deaths in 2021 (WHO, 2022). Similarly, illness cases due to dementia (symptoms of memory decline) tripled between 2000 and 2021, and ranked 3rd main cause of deaths in 2021 compared to 14th in 2000 (WHO, 2022). Stroke and heart diseases accounted for about 2 million lives in 2000. This mortality increased by more than 7 million in 2021 (WHO, 2022). While illnesses from heart diseases, diabetes, stroke, and all forms of cancer collectively responsible for nearly 100 million deaths, in total NCDs accounted for more than 71% of deaths globally in 2019 alone (WHO, 2020). All these accounted for low average life expectancy in developing countries.

Life expectancy in Nigeria has been performing poorly over the past few years and constitutes the lowest in most developing economies as Figure 1 indicates. The world average of 72.3 years in 2020, for instance, is by far higher (World Bank, 2024). But when compared with other low-income countries (especially Nigeria's counterparts), such as Angola, Benin, Burkina-Faso, Botswana, Ghana, Kenya, Liberia, Morocco, South Africa and Zimbabwe, Nigeria's average life expectancy was merely 52.9 years in 2020.

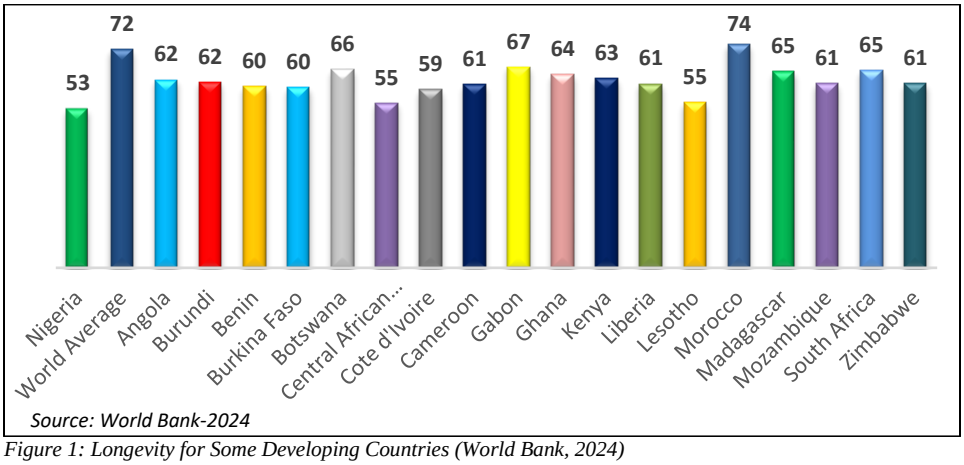

Figure 1: Longevity for Some Developing Countries (World Bank, 2024)

Until recently, interest in macroeconomic factors and their impacts on life expectancy has been rapidly growing among policymakers and development researchers. These factors are increasingly viewed based on the premise that they can improve economic development and longevity. Though studies have undertaken the nature and magnitude of macroeconomic factors, as well as their impact on the economic growth in Oman, Cambodia, Laos and Myanmar (Chen & Taylor, 2013; Wirayuda & Chan, 2022). But studies on African countries are largely limited. It is against the aforementioned backdrops that this research seeks to answer the following research questions: What are the long-run relationships between

macroeconomic factors and longevity in Nigeria? What are the major macroeconomic and socio-demographic determinants of life expectancy in Nigeria?

Be that as it may, this study explores the influence of macroeconomic dynamics on longevity between the period 1986 and 2020. The subsequent sections of this study proceed as follows: in section II, the study discusses the previous literature on the research issue. In section III, it explores the methodology, analytical framework and data analysis. Empirically findings from this study and their discussions were presented in section IV, and section V conclude by discussing the results in light of the macroeconomic base in Nigeria.

2. Literature Review

Longevity is an important index of people's health and a major indicator of evaluating economic, healthcare as well as environmental qualities (WHO, 2018). It is also one of the most important health indicator of mortality and overall health conditions used by health and socio-economic structures. Longevity is mostly measured at birth as index for comparison. It is computed for male and female sexes separately which is then summarized into the total life expectancy of a considered population (United Nations, 2019).

The Malthusian population theory postulated by Robert Malthus and Grossman model (1972) is the theoretical framework underpinning this study which established an indirect relationship between longevity, macroeconomic and socio-demographic variables. The theory predicted that given a linear production function of resources (mainly food supply), a sustained rise in population decreases economic well-being because the means of living will be eventually less than enough to sustain the living standard. In support of this, Aladejare (2023) established a more direct linkage between longevity, macroeconomic and socio-demographic variables. In this case, longevity was treated as the major cause of population growth and given a fixed supply of resources, an increase in longevity tends to decrease the subsequent growth rate of GDP per capita. However, this conclusion was severely criticized for the assumption of fixed resources which served as the pillar for the inverse relationship between longevity and economic well-being.

In another scenario, Grossman (1972) constructed a more practicable model in which he expressed health as a durable capital stock that can be increased by investment and reduced by age and shadow prices besides the prices for medical care. The model assumes that an individual inherits stock which is inversely related to age but increases with an increase in investment. The model also posited that people are the producers of health because they choose food and health care. Further, people are constrained in health, due to the scarcity of financial and natural resources (Odior et al., 2022). It can be derived from this theory that longevity as one of the major health outcomes has a larger tendency to be influenced by investment which is directly proportional to resources and wealth of nations in Adam Smith's reasoning.

Grossman (1972) also noted that unemployment and inflation may negatively affect the level of investment in health care and health services consumption and ultimately reduce longevity rate. As recalibrated by Hashlamoun et al. (2022), the Grossman model can be expressed as $H = F(Y, S, V)$. Where H denotes health output, Y represents the component of

macroeconomic variables, S measures the socio-demographic variables and V represents environmental factors.

There are several empirical studies which investigated the macroeconomic and socio-demographic determinants of longevity in developing and developed countries. Sede & Ohemeng (2018) used a vector error-correction framework to investigate the drivers of life longevity in Nigeria between 1980 and 2011. It was found that per capita income, education and public expenditure on health cause higher life expectancy in developing countries, but the result for Nigeria is insignificant.

Also, Aladejare (2023) examined external debt's impact on human longevity in West African countries from 1981 to 2020. Results revealed that external debt and macroeconomic volatility weaken longevity in the long run. But Miladinov (2020) investigated the relationship between socioeconomic factors and life expectancy in five EU countries (Macedonia, Serbia, Bosnia and Herzegovina, Montenegro, and Albania). The study found that longevity is significantly associated with GDP per capita and low infant mortality. In another development, Wirayuda, Jarallah, Al-Mahrezi, Alsamara, Barkat & Fai-Chan (2022) examined the impact of socio-economic factors and health resources on life expectancy in Oman and Qatar. It was found that macroeconomic factors affects life expectancy indirectly. From co-integration and ARDL framework, Adeosun, Gbadamosi & Odior (2022) investigated the nexus between macroeconomic variables and mortality rate. The study found a positive effect of GDP and inflation on death rate, and there are no evidence for long-run nexus among the variables. Rofa, Bucciol & Hashlamoun (2022) investigate the determinants of life expectancy in OECD countries. It was found that per capita healthcare and incidence of out-of-pocket expenditures, physician density, hospital bed density, social spending, GDP, temperature, and total size of the population affects life expectancy. Earlier, Kozlova, Makarova & Bedrina (2019) investigate the effect of social and economic factors on mortality of the working-age population in Russia. The study found that the macroeconomic variables strongly predict death rates of the working-age citizens.

In Nigeria, Felix (2023) adopted the autoregressive distributive lag technique, and the bounds co-integration test to estimate the impact of foreign sector macroeconomic indices on life expectancy using datasets spanning 1981-2021. The study revealed that per capita GDP causes increase in life expectancy, but increase in external debts reduces longevity in both short- and long-run. Again, exchange rate result in decline in longevity in Nigeria. In another development, Saidu, Abdullateef & Ahmed (2023) used the ARDL procedure to investigate the relationship between macroeconomic variables and life expectancy in Nigeria. The research found that inflation hurts longevity but economic growth increase life expectancy greatly.

Globally, few recent studies such as, Ahmed *et al.,* 2023 and Felix, 2023 were conducted to examine the long-run relationships among macroeconomic and socio-demographic variables on longevity. many studies reviewed in this research examined only a fraction of macroeconomic variables as they relate to longevity in developed and developing countries without exploring the socio-demographic pillar of it which constitutes a significant proportion of measuring longevity within the shore of Sub-Saharan African countries using the WHO's (2018) longevity computational index. However, of all the empirics in this research, only Sede

& Ohemeng (2018) explore the long-run dynamic nexus between socio-demographic variables and longevity in Nigeria using aggregated datasets from 1980-2011 but Sede & Ohemeng's (2018) findings were not clear as it did not capture the macroeconomic factors which form an integral part of measuring longevity index. Thus, to fill this gap, this study opted to employ disaggregated datasets spanning 1986-2022 to analyse the dynamic long-run relationship between macroeconomic variables (such as per capita income, domestic and external debts and socio-demographic variables (which includes household consumption expenditures and population growth rate) in relation to longevity in Nigeria.

3. Methodology

Life expectancy is the principal measure of longevity; hence this study tends to focus largely on it. Grossman (1972) proposed that longevity is a durable capital good which is inherited and reduces or depreciates over time. However, effective health inputs will result in improving long life. Thus, in line with the proposition of the Grossman model, the stock of health needed for longevity is given as:

$$H_t = f(H_{t-1}, T_t^H, M_t) \quad \text{.....1}$$

Where H_t is longevity, H_{t-1} is the stock of health in the previous years, T_t^H is the time people spend on improving their health to live long, and M_t is the market products or services people can purchase to improve long life, and t is the time. Equation (1) states that longevity depends on many factors. As recalibrated by Hashlamoun *et al.* (2022) and modified by this study, the Grossman model can be expressed as:

$$H_t = f(H_{t-1}, Y_t, S_t) \quad \text{.....2}$$

Where Y represent the vector of macroeconomic variables, and S measures the socio-demographic variables.

For this study, Y_t includes domestic and external debts and per capita incomes. Unlike previous studies in Nigeria, such as Felix (2023), these variables were proxied for macroeconomics because the nation is characterized by high debt crises and one of the lowest life expectancy rates in the Sub-Saharan Africa region (World Bank, 2024). For socio-demographic variables, the study considered consumption expenditure from households and population growth rate to predict longevity. Thus, equation (2) yields:

$$LE_t = f(LE_{t-1}, DD_t, ED_t, RGDP_t, CEH_t, PGR_t) \quad \text{.....3}$$

Where LE_t = Longevity proxy by average life expectancy; LE_{t-1} = Lag of longevity; DD_t = Domestic debts; ED_t = External debts; $RGDP_t$ = Real Gross Domestic Product or per capita income; CEH_t = Consumption expenditure from households; PGR_t = Population growth rate. The dataset for these variables were gotten from Central Bank of Nigeria, National Bureau of Statistics, as well as World Bank Development Indicators for various years.

4. Results

Table 1 present the summary statistics for longevity rate. It also includes the characteristics of macroeconomic and socio-demographic variables in Nigeria. The mean longevity in Nigeria is 49 years, with a maximum of 54 years in 2022. This is particularly low compared to the maximum life expectancy in Ghana (64 years), Angola (62 years), Burundi (63 years),

and Benin (60 years) in the same African region (World Bank, 2023). On the other hand, unit root test for the series were presented in Table 2. With the exclusion of domestic debts (InDD) that have no unit root at level, all others are stationary at their 1st differences. Thus the chosen dependent, explanatory and control variables have no unit roots at different levels. Hence, this study applied the ARDL model for its co-integration analysis.

Table 1. Summary Statistics

Variables	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.	Obs.
LE	48.95	48.76	54	45.48	2.85	0.15	1.47	3.74	0.15	37
DD	7.17	7.22	9.78	3.34	1.91	-0.40	2.13	2.14	0.34	37
ED	7.107	6.79	9.46	3.72	1.41	-0.12	2.51	0.45	0.79	37
RGDP	6.95	6.90	8.07	5.59	0.76	-0.05	1.42	3.85	0.14	37
CEH	8.82	9.27	11.77	4.40	2.35	-0.47	1.93	3.14	0.20	37
PGR	2.59	2.58	2.76	2.40	0.09	-0.07	2.01	1.53	0.46	37

Source: Authors compilations (2024)

Table 2. Unit root Results

	ADF		Remarks
	Level	1st Difference	
LE	1.8049	-5.8786*	I(1)
InDD	-2.9962*	-4.2632*	I(0)
InED	-1.4433	-4.3804*	I(1)
InRGDP	-0.4810	-4.7824*	I(1)
InCEH	-2.5792	-4.8337**	I(1)
PGR	-1.7048	-3.3037**	I(1)
Critical values	ADF test: 1% = -3.6329; 5% = -2.9484; and 10% = -2.6128		

Note: (***), (**) and (*) means significant at 1%, 5% level, and 10% level, respectively
Source: Authors' computations (2024)

The model needs the optimal lag length before applying the ARDL test, thus the study chose the Akaike information criterion (AIC) method. The lower AIC values are always the better-fit model. It was found that the optimal lag length was (4, 3, 2, 1, 2, 1). The study then proceeds to test F-statistics from the bound test as shown in Table 3. From Table 3, the F-statistics of 7.8395 is higher than the critical values at a 1% significant level. The finding provides evidence of co-integration, and hence a long-run association among the variables included in the model.

Table 3. F-statistics from Bound test Results

Test Statistics	Value	Significance	I(0)	I(1)
F-statistics	7.8395	1%	3.29	4.37
k	4	5%	2.56	3.49
		10%	2.20	3.09

Source: Authors computations (2024)

Table 4 shows the results for ARDL long-run coefficients. The long-run findings suggest that the lagged value of domestic debts has an inverse impact on life expectancy at 10% level. The finding suggested that an increase in domestic debts will reduce longevity in Nigeria. The lagged value of external debts also has an inverse influence on longevity in the long-run at a

5% level. However, per capita income has a direct impact on longevity in the long run. This suggests that as per capita income is increasing, they are likely to have an improvement in life expectancy in the long run. The lagged values of consumption expenditure by households in Nigeria also have a negative significant relationship with longevity in the long run at a 5% level. This suggests that as household expenditure is increasing, this might limit their resources with perhaps low/zero savings to maintain their health status or to access health-promoting goods and services, thereby constraining longevity. Population growth rates have a direct but insignificant effect on longevity. This suggests that as the population is increasing, they are likely to reduce life expectancy in the long-run.

Table 4. ARDL Long-run results Estimation with lag (4, 3, 2, 1, 2, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LE(-1)	0.7681	0.4539	1.6922	0.1892
LE(-2)	-1.1964**	0.2619	-4.5669	0.0197
LE(-3)	0.4701	0.3205	1.4661	0.2388
LE(-4)	1.1363**	0.2295	4.9511	0.0158
LNDD	1.3287	1.2298	0.5076	0.2871
LNDD(-1)	-1.2278*	0.4528	-2.7115	0.0731
LNDD(-2)	-0.4177	0.3350	-1.2468	0.3009
LNDD(-3)	-0.2522	0.2649	-0.9520	0.4113
LNED	0.0025	0.0841	0.0305	0.9776
LNED(-1)	0.4563**	0.1101	4.1445	0.0255
LNED(-2)	-0.5666**	0.1391	-4.0710	0.0267
LNRGDP	-0.7464	0.4375	-1.7059	0.1866
LNRGDP(-1)	1.6540**	0.3649	4.5327	0.0201
LNCEH	0.5655*	0.2297	2.4614	0.0907
LNCEH(-1)	-0.8720*	0.2839	-3.0708	0.0545
LNCEH(-2)	-0.4071*	0.1523	-2.6719	0.0756
PGR	5.8347***	1.2854	4.5391	0.0200
PGR(-1)	-1.0960	1.6053	-0.6827	0.5438
Intercept	-19.4794	13.2195	-1.4735	0.2370
R^2 = 0.9895				
$Adjusted\ R^2$ = 0.9596				
F-stat. – 3510.83				
Prob (F-stat.) – 0.0000				
Durbin Watson – 3.0470				

Note: (***), (**) and (*) means significant at 1%, 5% level, and 10% level, respectively
Source: Authors' computations (2024)

Findings from the long-run estimation (as presented in Table 4) then confirmed that Nigerians' longevity relied on both macroeconomic and socio-demographic characteristics. Results further show that government can enhance and promote longevity by reducing both domestic and external debts and improving per capita income, and households should also reduce consumption expenditure and increase spending on health-promoting goods and services. Then both the government and household should also reduce the population growth rate in Nigeria. The result corresponds with Felix (2023) which states that an increase in per

capita GDP will improve longevity and an increase in external debts will reduce life expectancy.

The short-run results of this study are presented in Table 5. It provides that domestic debts have a negative significant relationship with life expectancy but are not significant. The finding suggests that an increase in domestic debts in the short run will reduce longevity in Nigeria. The external debts also have an inverse significant relationship with longevity in the short-run at a 10% level. However, per capita income has a positive and significant impact on longevity in the short run. This suggests that, as per capita income is increasing, they are likely to have an improvement in life expectancy. The estimate of consumption expenditure by households in Nigeria also has an inverse significant relationship with longevity. This result is not significant statistically but suggests that as household expenditure is increasing, this might limit their resources with perhaps low/zero savings to maintain their health status or to access health-promoting goods and services, thereby constraining longevity. The growth of the population rate has a positive and significant impact on longevity. This suggests that as the population is increasing in the short-run, they are likely to reduce life expectancy in Nigeria.

Table 5. Short-run results Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.3343	0.0680	4.9106	0.0000
D(LNDD)	-0.3520	0.2941	-1.1967	0.2411
D(LNED)	-0.0106*	0.0857	-0.1237	0.0902
D(LNRGDP)	0.4132*	0.4799	1.4759	0.0150
D(LNCEH)	-0.2458	0.2094	-1.1735	0.2501
D(PGR)	4.1052***	1.0639	3.8585	0.0006
$CointEq(-1)$	-0.2596**	0.1037	-2.5026	0.0182
R-square = 0.5717				
Adjusted R-square = 0.5624				
F-statistics – 4.3169				
Prob (F-statistics) – 0.0000				
Durbin Watson – 1.5200				

Note: (***), (**) and (*) means significant at 1%, 5% level, and 10% level, respectively
Source: Authors' computations (2024)

It is expected that the error correction term (ECT) should inversely affirm the long-run and short-run relationship of the variables statistically. Findings from this study revealed that ECT is -0.2596, and this is significant at 1% level. It means that the adjustment speed term converges to the long-run state of rest by 25%. It shows that a 25% deviation from the long-run equilibrium in life expectancy is improved annually.

Table 6. Diagnostic test results

Test Statistics	F-statistics	Probability
Breusch-Godfrey LM test	1.0728	0.9300**
Heteroskedasticity (ARCH) test	0.4623	0.5013*
CUSUM test	Stable	

Source: Authors' computations (2024)

This study also applied the diagnostics tests and the results are presented in Table 6. The tests are important to confirm the model's stability, serial and normality correlation, and heteroskedasticity. For this study, the Godfrey test and ARCH are employed to check the serial correlation of the residuals in the model, and the heteroskedastic issue of the model, respectively. CUSUM tests were used to test the study's model stability.

The Breusch-Godfrey LM test result has the F-stat. of 1.0728 with high probability value of 0.9300 as shown in Table 6. These results indicate no serial correlation issues. Similarly, the ARCH test has the F-statistics of 0.462 with a significant probability of 0.5013. This shows no heteroskedasticity issue in the estimation. This study conducted a stability test which show that the model is stable.

5. Conclusion and Recommendations

This study estimates the impact of macroeconomic and socio-demographic characteristics on longevity in Nigeria spanning from 1986 to 2022 using the Auto-regressive Distributive Lag (ARDL) model. This research concluded that Nigeria's domestic debt, external public debt, population growth rate impacted longevity in the long-run significantly. On the other hand, the consumption expenditures by household and per capita income were statistically significant and exerted a positive contribution to longevity in Nigeria. The ECT indicate that a 25% deviation from the long-run equilibrium in longevity is improved annually. Following the results from this investigation, the research recommends that effort to reduce both domestic and external debts in Nigeria should be pursue by the policy makers. Strategies to improve the welfare of citizens should also be the central focus of the government.

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