Unilag Journal of Mathematics and Applications,
Volume 1, Issue 2 (2021), Pages 154—171.
ISSN: 2805-3966. URL: http://lagjma.edu.ng

EXAMINING THE EFFECT OF AGE DISTRIBUTION AND HEALTH INSURANCE BUSINESS ON NIGERIAN ECONOMIC GROWTH

By

WILLIAMS, HARLEY TEGA* AND MOJEKWU, JOSEPH N.

ABSTRACT. *This study has demonstrated new evidence sustaining the idea that age distribution and health insurance affect economic growth in Nigeria. Life table that was computed based on substantial assumptions using 1990 Nigeria population data and a death rate of 18.55%, the study examines total person-years of life contributed after attaining age x as a proxy for age distribution* (T_x) *and the average number of years of life remaining for a person alive at the beginning of age interval x after adjustment with life expectance rate as at the year 1990 of 3% as proxy for health insurance* (H_i)*. To achieve the objectives, research questions and hypotheses were formulated for age distribution, health insurance and economic growth. The variables* T_x, H_i *and GDP were subjected to normality test* as *normality of data is one of the standardized requirements for any least square regression. The P-values obtained from the Ordinary Least Square regression result was used to test the formulated hypotheses at 5% level of significance and the result revealed that age distribution* (T_x) *and health insurance* (H_i) *affects economic growth in Nigeria, while the Cobb-Douglas production function model shows that as the age distribution interval of person's in the life table increases, there is a slight fall in economic growth. The Cobb-Douglas model also shows an increasing return to scale which was supported by the presence of health insurance* (H_i) *in the model. The study recommends age distribution and health insurance as essential variables in formulating economic growth policy.*

2010 *Mathematics Subject Classification*. 92B05, 92D30, 93D20.
Key words and phrases. Age distribution; health insurance; regression; economic growth; Cobb-Douglas model; life table.

Submitted: April 7, 2021. Revised: September 11, 2021. Accepted: February 3, 2022.
*Correspondence.

1. Introduction

1.1. **Preliminaries.** As a result of the linkage between population and economic growth (Crenshaw 1997), understanding the fundamental factors of a population and its impact on economic growth is essential for economic growth. In the year 2020, an alarming proportion of the world died and economic activities destroyed as a result of the Corona Virus Disease (COVID-19) pandemic. David and (2018) states that pandemic occur in every one hundred years and causes damages to economic activities and human health. However, most health insurance providers in developing countries are skeptical in making adequate preparation and provision to combat such unprecedented risks or pandemic if they occur.

In Nigeria, finance and economic activities nosedived continuously, attesting to the negative impact caused by COVID-19, while population statistics were taken daily to show the trend of deaths caused by COVID-19. Bedford (2020) states that Age distribution statistics attests that older adults were affected more by COVID-19 than younger adults. Most health insurance organizations in Nigeria avoid new health insurance policy for older adult during the first phase of COVID-19 thereby making health insurance business in Nigeria a profit making organizations rather than risk management institutions. Demographic factors such as age distribution status are essential for assessing economic growth and development of any society; as age distribution has been noted by Diep and Hoai (2015) to have a contributory impact to economic growth, while health insurance provision is a good representation of the health of a nation. During the COVID-19 period in the United State of America in the year 2020, adequate attention on healthcare was given to a particular age group of people, as age distribution is an indicator of the future direction of the growing economy. Demographic changes can influence the underlying growth rate of any economy, structural productivity growth, living standards, savings rates, consumption and investment. Age distribution can influence the long-run unemployment rate, housing market trends, and the demand for financial assets and health care services. Moreover, differences in age distributions across countries can be expected to influence countries' national income and make it necessary for someone to understand changes in demographics. Crenshaw (1997), understanding the variation in the factors of population seems to be a necessity for the process of economic growth and development as stable economic growth cannot exist in isolation from a good health care system. Many countries had carried studies to find out the linkage between demographic factors and economic growth.

As the year 2020 went by, the need to enhance and sustain healthcare development became an essential goal for government and all stakeholders in West Africa. Adequate preparation, strategic thinking, scientific research, appropriate data and statistics are amongst the strategies that aid healthcare development and strengthen health insurance. The level of healthcare development compared to demographic distribution in Nigeria is still low and needs to be tapped from the enormous resources available in Nigeria. Owolabi (2017) stated that the Nigeria healthcare sector has over time failed and insufficient to address necessary healthcare delivery policy for Nigerians and the proportion of doctors to patients for stable healthcare delivery system in Nigeria.

Health insurance and age distribution are essential variables for assessing economic growth of any economy hence the need to harness these variables for proper output. As a result of the linkage between population and health care, understanding the variation in population factors seems to be a necessity for the process of economic and health care development (Crenshaw 1997). Age distribution and healthcare are critical variables to be considered in the period of pandemic. Investigating age distribution and health in Nigeria has been intriguing to researchers over the years. Most of the investigations on healthcare and demographics were done mainly with an objective or for the motive of assessing the impact of income and age on economic growth. No focus study had looked into age distribution and health insurance on economic growth. Bloom and Williamson (1998) demonstrated a significant improvement in economic growth and development in Asia in the period from 1965 to 1990 using healthcare variables and age distribution. In as much as age distribution and healthcare play a significant role in forecasting population, their impacts has not been seen or measured on economic indicators like gross domestic product. It is on the basis of this premise that the study is being carried out to examine the impact of age distribution and health insurance on Nigerian economic growth.

1.2 Literature Review

The impact of population growth and age structure on a nation's growth and development from the Malthus's theory shows that demographic factors are essential for economic growth while the endogenous growth theory states that investment in knowledge is a significant contributor to growth and development. The Malthus's theory and the endogenous growth theory are the theories in which the researchers anchor the idea of this study. However there are some literatures that provide supportive evidence for pessimistic view. Pintu and Predip (2020) states that demographic factor and health care are major public health problem, they further stress that adequate utilization of health care facility in terms of maternal health care services could be an effective means for reducing maternal mortality when demographic factors are considered. Paul (2019) stated the importance in demographic factors and health in analysing child marriage and maternity health care. Nonokpono, Gayawan and Adedini (2019) show the relevance of demographic factor with emphasis on age in grouping women for postnatal health care. International Institute for Population Sciences (IIPS) (2018) states the importance of demographic distribution in population planning in Indian. Coale and Hoover (1958) built up a hypothesis based on an Indian database about the negative relationship between demographic factor such as age in young dependence and savings in a short run which lower the standard of living. Bloom (2003) show that the rapid growth of population requires a large part of technological improvement in health care as well as fixed resources such as home, infrastructure and so on. Thus, the raise in productivity could not make significant change in standard of living. Until 1800, the gap between the countries with high technology like England, France, Germany and low-technology countries in Asia and Africa is still small. The empirical review in recent decades such as Barlow (1994), Kelley and Schmidt (1995) also find an evidence about negative correlation between population growth and income per capita with panel database as younger population seems not to be productivity due to low health care delivery. The empirical study in recent decades also provide an inconsistent result, while some papers find the negative effects, others find positive or no relationship. The study about 110 countries in the period of 1960-2000 of Azomahou and Mishra (2008) shows that contrary to the negative influence on economic growth in OECD countries, the total population growth make a positive effect in non-OECD countries. Moreover, Bloom and Williamson (1998) sustained that raise in population bolster the miraculous growth in East Asia during the period from 1965 to 1990.

In addition, the empirical studies concern more about the age structure since it provides more information for implied policy. Crenshaw (1997) found that the economic growth in 75 developing countries was hindered by raise in young dependence, though the effect of increase in working population still positive. In addition, the research of Azomahou and Mishra (2008) into about 110 countries from 1960 to 2000 shed light on the growth of each group (0-14, 14-64, 65 and above) shows some different results. The increase in young and working age population have positive contribution to growth in both OECD and non-OECD countries which shows a normal distribution of demographic variables, yet the negative trend was found in non-OECD countries which could be the implication for population-control policy in these countries. The ageing population was found in both group of countries, though the effect in OECD was more serious than in non-OECD. Barro and Lee (1994), Caselli et al. (1996), Gallup and Sachs (2000) come into the same results with different econometric method that life expectancy have significantly positive effect on per capita output when per capital out is proxy with economy growth and development. The recent study from Ashraf (2008) proved that per capita output have tended to be higher by appropriate 15% in the long-term since the life expectancy raises from 40 to 60 subject to improvement in health care development and appropriate distribution of demographic factors. Bloom et al. (2003) confirmed the promotional contribution of life expectancy on income per capita due to increase in worker's productivity is about 4% per year. Along the same time, De la Croix (2009) also concerned this nexus and find positive correlation between two proxies. On the other hand, some results find that the longer life may not improve income per capita in long run. Acemoglu and Johnson (2007) provide an opposite finding to most of previous studies: the increase in life expectancy contributes to the reduction in economic growth based on cross-country database over the 1940-2000 periods. De la Croix and Licandro (2009) built up an overlapping generation's model to consider the relationship between life expectancy and growth, their study suggests that the economic growth may be pushed up by the low levels of life expectancy. In contrast, the economic would tend to be exacerbated when the countries is more developed due to the ageing population. Evidence from research of McDonald and Roberts (2002) also supports the idea of de la Croix and Licandro, their finding exposes that despite the supportive role of longer life in developing countries, income per capita in OECD countries was depressed because of ageing of their population.

2. Materials and Methods

Cobb–Douglas was developed and tested against statistical evidence by Charles Cobb and Paul Douglas between 1927–1947. Cobb–Douglas production function is a functional model used in economics and econometrics to represent the amounts of two or more inputs and the amount of output that can be produced by those inputs. We used the Cobb Douglas model to test the linear relationship that exists between age distribution and health insurance business on Nigerian economic growth. Other statistical techniques were also used to further analyzed the data. In this note, the researchers focus on statistical tools in the field of economics and econometrics called the Cobb–Douglas production function. The Cobb–Douglas function is a particular functional form of the production function, widely used to represent the technological relationship between the amounts of two or more inputs and the amount of output that can be produced by those inputs.

A standard Cobb–Douglas production is:

$$Y = AL^{\beta}K^{\alpha}$$

Where:

Y = total production (the real value of output)

L = labor input

K = capital input

A = measure efficiency of the production

α and β are the output elasticities or measure the factor intensity.

$\alpha + \beta = 1$,constant returns to scale

$\alpha + \beta < 1$, decreasing returns to scale

$\alpha + \beta > 1$, increasing returns to scale

The researchers there Where

Y = GDP = Economic Growth

L = T_x = Age distribution

K= H_i = Health Insurance

A= R^2 = coefficient of determination among the variables

α and β are proxied with standard errors

2.1 Model Specification

The Cobb-douglas model for the study is hereby specified as follows:

$$Q = AK^{\alpha}L^{\beta} \quad (1)$$

The study Model is thereby written in Cobb–Douglas form:

$$GDP = T_x^{\alpha} H_i^{\beta} \quad (2)$$

To obtain A= R^2 the study used the Least Square Regression (OLS)

α and β are obtained from the OLS results

$$LOGGDP = \beta_0 + \beta_1 LOGT_X + \beta_2 LOGH_i \quad (3)$$

The table was computed using the following assumptions

Population of Nigeria as at the year 1990= 95,000,000

Death rate in Nigeria as the year 1990= 18.55%

Death rate of 1% reducing balance method after the year 1990.

Table 1 Life Table Data presentation

Age	**d_x**	**Fx**	**q_x**	**p_x**	**l_x**	**T_x**	**e_x**
1990 (1yr)	17622.5	95000	0.1855	0.8145	133688.75	7453224.877	78.4549987
.							
.							
.							
100	286.0875504	28608.75504	0.01	0.99	28608.75504	28608.75504	1
					7453224.877		

Source: computed with excel using population data of 1990 and death rate of 1990 (see appendix)

Table 2 Extracted Data from the Life Table Data

Age interval	T_x	e_x	Δ in Life exp. Rate @ 3%	H_i
15-19	28011020	425.0507	1.03	437.8022
20-24	25597132	408.433	1.03	420.686
25-29	23301548	390.959	1.03	402.6878
30-34	21118471	372.5844	1.03	383.7619
35-39	19042387	353.2628	1.03	363.8607
40-44	17068051	332.9455	1.03	342.9339
45-49	15190477	311.5812	1.03	320.9286
50-54	13404923	289.1158	1.03	297.7893
55-59	11706879	265.4926	1.03	273.4574
60-64	10092056	240.652	1.03	247.8716
65-69	8556376	214.5312	1.03	220.9671

Source: computed with excel using life expectancy growth rate of 1990 @ 3% (see appendix)

Table 3: Descriptive Statistics of the Data

	LOGGDP	$LOGT_x$	$LOGH_i$
Mean	2.62000	7.344000	1.828000
Median	2.40000	6.510000	1.780000
Maximum	3.10000	8.300000	2.360000
Minimum	2.10000	4.700000	1.440000
Std. Dev.	3.08018	1.236621	1.335965
Skewness	0.000333	0.260043	0.406144
Kurtosis	1.924252	1.994761	1.797557
Jarque-Bera	3.134176	3.469360	5.702883
Probability	0.208652	0.176457	0.057761
Sum	2120.300	412.3600	118.8200
Sum Sq. Dev.	607.2040	97.87076	7.223840
Observations	11	11	11

Source: Computed using Eview9 2020.

According to table 3, all variables comprised 11 observations. The variables are LOGGDP, $LOGT_x$ and $LOGH_i$. The need for the descriptive statistics is to ascertain some information to test the normality of the data.

Test for Normality of the Variables using Jarque-Bera.

The test for normality was conducted using Jarque-Bera value against Chi-square value of 5% and 7df. JB<Chi square critical value, then there exist a normality among the variables.

Table 3.1: Normality Table

Variables	Value of Jarque-bera (JB)	Critical Chi-square value of 5%SF @ 7df	Validity
LOGGDP	3.134176	14.067	JB<Chi-square
$LOGT_x$	3.469360	14.067	JB<Chi-square
$LOGH_i$	5.702883	14.067	JB<Chi-square

Source: Extracted from Table 3 and chi-square table

2.2 Cobb-Douglas Production Function

In order to examine the effect of Age distribution and health insurance on economic growth in Nigeria, the model for the study is hereby specified as follows to derived the efficiency variable A= R^2 and the α and β

$$GDP = T_x^{\alpha} H_i^{\beta}$$

To obtain A= R^2 the study the Least Square Regression (OLS)

$$LOGGDP = \beta_0 + \beta_1 LOGT_X + \beta_2 LOGH_i$$

Table 4: Least Square for Variables

Dependent Variable: LOGGDP
Method: Least Squares
Date: 01/30/21 Time: 12:52
Total observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	28.77220	1.560012	18.443576	0.0000
LOGT_x	20.78889	1.860013	11.176745	0.0000
LOGH_i	26.75235	2.420012	11.054635	0.0000

R-squared	0.820000	Mean dependent var	32.62000
Adjusted R-squared	0.817000	S.D. dependent var	3.080189
S.E. of regression	1.820013	Akaike info criterion	-52.60069
Sum squared resid	0.670023	Schwarz criterion	-52.43343
Log likelihood	07.14523	Hannan-Quinn criter.	-52.53470
F-statistic	1.950026	Durbin-Watson stat	2.269967
Prob(F-statistic)	0.000000		

Source: Computed using Eview9, 2021.

3. Result

Table 4 shows the relationship between the gross domestic product and the variables proxies for age distribution and health insurance. The main objective of carrying out the OLS test is to determine the Coefficient of Determination (R^2) which can be proxy for efficiency in the Cobb Douglas function while the standard errors are proxies for factor intensity.

The coefficient of determination is very high which shows that about 82 percent of the total variations in LOGGDP are explained by all the independent variables. The adjusted R^2 also indicates that about 81.7 percent of the total variations in LOGGDP are explained by the functional relationship. This indicates that the dependent variable and the independent variables are good fit. The F-statistic is significant at 5 percent critical level. It indicates that the joint variations of the model are significant. The F-statistics calculated in the model shows that 1.95002. The F-statistics tabulated is noted to be 1.96. From this statistical analysis, it is noted that the model should be accepted because it is statistical significant to the study.

In order to test the hypothesis which states that Health insurance practice does not influence economic growth in Nigeria, the loglinear regression was carried out and the results shown in table 4.

$$LOGGDP = \beta_0 + \beta_1 LOGT_X + \beta_2 LOGH_i$$

Table 5: Extracted from Table 4 showing the t-test of Health Insurance.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGH_i	26.75235	2.420012	11.054635	0.0000

Source: Extracted from regression result in Table 4

The use of T-test to test hypothesis if the independent variable is statistical significant to the dependent variable. The variable to be tested here is Health insurance (H_i) against GDP. The reason for the test is to validate the research question and the objective that the researcher had in mind before stating the hypothesis in chapter one and to find out how statistically significant the variables are and if they corroborate with other empirical literatures. The P-value is compared with that of 5% confidence interval. The H_i which is a proxy for health insurance is 0.0000 which is the P-value, and is therefore compared with 0.05 i.e. 0.0000<0.05 we conclude that health insurance (H_i) affect economic growth (GDP).

In an attempts to test the hypothesis which states that total person-years of life contributed after attaining age x (T_x) has no significant impact on economic growth in Nigeria, loglinear analysis was carried out and the results shown in table 4.

$$LOGGDP = \beta_0 + \beta_1 LOGT_X + \beta_2 LOGH_i$$

Table 6: Extracted from Table 4 showing the t-test of Age distribution.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGT_x	20.78889	1.860013	11.176745	0.0000

Source: Extracted from regression result in Table 4.4.1

The p-value for LOGT_X is 0.0000 and is therefore compared with 0.05 i.e. 0.0000<0.05 we conclude that by rejecting the null hypothesis. Therefore age distribution affects gross domestic product.

The Cobb Douglas Production Function

The Cobb-douglas model for the study is hereby specified as follows:

$$Q = AK^{\alpha}L^{\beta} \quad (1)$$

The study Model is thereby written in Cobb–Douglas form:

$$Q = A(T_x^{\alpha} H_i^{\beta}) \quad (2)$$

Where A= 82%= 82 α= 1.86 β= 2.42

$$Q = 82(LOGT_X^{1.86}\, LOGH_i^{2.42}) \quad (3)$$

Table 7 Cobb-Douglas Production Function Output (Q) with Equation 3

Age distribution	$LOGT_x$	$LOGH_I$	Q
15-19	7.447329	2.641278	36018.45
20-24	7.408191	2.623958	35103.8
25-29	7.367385	2.604968	34139.62
30-34	7.324662	2.584062	33120.12
35-39	7.279721	2.560935	32038.48
40-44	7.232184	2.53521	30886.52
45-49	7.181571	2.506408	29654.29
50-54	7.127264	2.473909	28329.51
55-59	7.068441	2.43689	26896.68
60-64	7.00398	2.394227	25335.84
65-69	6.93229	2.344328	23620.49

Source: computed with excel

4. Discussions

The Cohort or Generation Life Table was the focal point in which the data of the study was used as proxies for age distribution and health insurance after adjustment.

The komogorov test for normality shows that the variables used in the study follow a normal distribution. The probability value for age distribution, health insurance and economic growth shows 0.0000 indicating that the variables are statistically significant. The coefficient of determination R^2 of 82% shows that the model is a good fit and that substantial proportions of the independents variables are captured by the dependent variable. The R^2 of 82% was used as proxy for efficiency in the Cobb-Douglas production function. The test for autocorrelation using Durbin-Watson statistics justify that null hypothesis should be rejected and that there is a serial correlation in the data. The test of hypothesis using the t-statistics confirmed that age distribution and health insurance business affect economic growth in Nigeria. The Cobb-Douglas production function shows that there is an increasing return to scale and attests that age distribution and health insurance affect economic growth in Nigeria. The Cobb-Douglas production function also shows that as the age of individuals increase, the production capacity declines. Health insurance is a supporting factor to economic growth as shown from the production function.

5. Conclusion

This study has examined the effect of age distribution and health insurance business in Nigerian economic growth. It found out that the combination of age and health insurance could produce rapid economic growth and development in Nigeria. Age is one of the sole aims of health insurance providers. Therefore, aging participants should be given a rebate after age 69. A person of reproductive age should have access to different types of health insurance so as to be active. The findings of the study show the importance of the Ordinary Least Square method and the Cobb-Douglas production function in examining the effect of age distribution and health insurance business on Nigerian economic growth. The Cobb-Douglas production function shows that the combination of age and health insurance is an increasing function to economic growth and that the age distribution plays a great impact on economic growth in Nigeria and as the age increase the economic production declines. Therefore, efforts to improve special health insurance policy should be created for Nigerian citizens so that the impact of age distribution on economic growth can be attained. Also a structured cohort life table should be put in place to checkmates mortality impact on economic growth in Nigeria.

Authors' Conflicts of interest. None.

Funding Statement. None

References

[1] D. Acemoglu and S. Johnson, Disease and Development: The Effect of Life Expectancy on Economic Growth. Journal of Political Economy. 115(6), (2007), 34-47.

[2] T. Azomahou, and T. Mishra, Age dynamics and economic growth: Revisiting the nexus in a nonparametric setting. Economics Letters. 99(1), (2008), 67-71.

[3] R. Barlow, Population growth and economic growth: Some more correlations. Population and Development Review, (1994), 153-165.

[4] S. Bedford. The End of World Population Growth in the 21st Century: New Challenges for Human Capital Formation and Sustainable Development. Routledge (2020).

[5] D. E. Bloom, and J. G. Williamson. Demographic transitions and economic miracles in emerging Asia. The World Bank Economic Review, 12(3), (1998), 419-455.

[6] D. E. Bloom. The effect of health on economic growth: a production function approach. World development, 32(1), (2003). 1-13.

[7] R. J. Barro and J. W. Lee. Sources of economic growth. In Carnegie-Rochester conference series on public policy, North-Holland. (1994) (40), 1-46.

[8] F. Caselli, G. Esquivel and F. Lefort. Reopening the convergence debate: a new look at cross-country growth empirics. Journal of economic growth, 1(3), (1996), 363-389.

[9] S. Crenshaw. Population dynamics and economic development: Age-specific population growth rates and economic growth in developing countries, 1965 to 1990. American Sociological Review. (1997), 974-984.

[10] A. J. Coale and E. M. Hoover. Population growth and economic development in low income countries: a case study of Indias prospects. (1958).

[11] D. Cuberes and M. Teignier. Gender inequality and economic growth: a critical review. Journal of International Development. 26(2), (2014), 260-276.

[12] A. David. Demographic structure and economic growth: Evidence from China. Journal of Comparative Economics. 38(4), (2018), 472-491.

[13] D. De la Croix. Demographic change and economic growth in Sweden: 1750–2050. Journal of Macroeconomics. 31(1), (2009), 132-148.

[14] M. A. Diep and N. T. Hoai. Demographic Factors And Economic Growth: The Bi-Directional Causality In South East Asia. Paper submitted to The ninth Vietnam Economists Annual Meeting. Da Nang City, 11 – 12th August 2015.

[15] J. L. Gallup and J. D. Sachs. The economic burden of malaria. The American journal of tropical medicine and hygiene. 64(1), (2001), 85-96.

[16] International Institute for Population Sciences (IIPS), ICF. National Family Health Survey (NFHS-4), 2015-16. Mumbai: International Institute for Population Sciences; 2017 Available at: http://rchiips.org/nfhs/NFHS-4Reports/India.pdf, Accessed date: 15 November 2018.

[17] J. M. Loretta. Demographics and Their Implications for the Economy and Policy. Paper presented at the Cato Institute's 35th Annual Monetary Conference: The Future of Monetary Policy Washington, DC. (2017).

[18] T. R. Malthus. An essay on the principle of population. Oxford University Press (reprinted in 1993), Oxford. (1798).

[19] S. McDonald and J. Roberts. Growth and multiple forms of human capital in an augmented Solow model: a panel data investigation. Economics letters. 74(2), (2002), 271-276.

[20] S. Miguel, A. Gemma and S. Guadalupe. Contribution of demography to economic growth. SERIES International Journal Spain. (2018), 27-64.

[21] DN. Ononokpono, E. Gayawan and SA Adedini. Regional variations in the use of postnatal care in Nigeria: a spatial analysis. Wealth & Health. (2019). https://doi.org/10.1080/03630242.

[22] V. Schmidt. "Age and Productivity Capacity: Descriptions, Causes and Policy Options," Ageing Horizons 8. (2001), 4-12.

(http://pure.iiasa.ac.at/8588/1/ageing_horizons_8_skirbekk_ll.pdf).

[23] A. Owolabi. Population change and aggregate output. In Demographic and economic change in developed countries. International Journal of Academic Research. (2017), 324-351.

[24] P. Pintu and C. Pradip. Socio-demographic factors influencing utilization of maternal health care services in India. Clinical Epidemiology and Global Health. (2020)(8), 666-670.

[25] J. W. Shaw, W. C. Horrace and R. J. Vogel. The determinants of life expectancy: an analysis of the OECD health data. Southern Economic Journal. (2005). 768-783.

[26] United Nations.World Population Ageing 2013. New York: United Nations (2013).

[27] World Health Organization. *Coronavirus Disease 2019 (COVID-19): Situation Report 100*. Geneva (2020).

Williams, Harley Tega

Department of Finance, Redeemer's University, Osun State, Nigeria.

Email: williamsh@run.edu.ng

Mojekwu, Joseph N.

Department of Actuarial Science and Insurance, University of Lagos

Email: jnmoje@yahoo.com

Data Appendix

Age	d_x	f_x	q_x	p_x	L_x	T_x	e_x
1990	17622.5	95000	0.1855	0.8145	133688.75	7453224.877	78.4549987
1	773.775	77377.5	0.01	0.99	115679.3625	7319536.127	94.59514881
2	766.03725	76603.725	0.01	0.99	114522.5689	7203856.764	94.04055435
3	758.3768775	75837.68775	0.01	0.99	113377.3432	7089334.196	93.48035793
4	750.7931087	75079.31087	0.01	0.99	112243.5698	6975956.852	92.91450296
5	743.2851776	74328.51776	0.01	0.99	111121.1341	6863713.283	92.34293228
6	735.8523259	73585.23259	0.01	0.99	110009.9227	6752592.149	91.76558817
7	728.4938026	72849.38026	0.01	0.99	108909.8235	6642582.226	91.18241229
8	721.2088646	72120.88646	0.01	0.99	107820.7253	6533672.402	90.59334575
9	713.9967759	71399.67759	0.01	0.99	106742.518	6425851.677	89.99832904
10	706.8568082	70685.68082	0.01	0.99	105675.0928	6319109.159	89.39730206
11	699.7882401	69978.82401	0.01	0.99	104618.3419	6213434.066	88.7902041
12	692.7903577	69279.03577	0.01	0.99	103572.1585	6108815.724	88.17697384
13	685.8624541	68586.24541	0.01	0.99	102536.4369	6005243.566	87.55754933
14	679.0038296	67900.38296	0.01	0.99	101511.0725	5902707.129	86.93186801
15	672.2137913	67221.37913	0.01	0.99	100495.9618	5801196.057	86.29986668
16	665.4916534	66549.16534	0.01	0.99	99491.00218	5700700.095	85.66148149
17	658.8367368	65883.67368	0.01	0.99	98496.09216	5601209.093	85.01664797
18	652.2483695	65224.83695	0.01	0.99	97511.13123	5502713	84.36530098
19	645.7258858	64572.58858	0.01	0.99	96536.01992	5405201.869	83.70737473
20	639.2686269	63926.86269	0.01	0.99	95570.65972	5308665.849	83.04280276
21	632.8759406	63287.59406	0.01	0.99	94614.95313	5213095.19	82.37151794
22	626.5471812	62654.71812	0.01	0.99	93668.80359	5118480.236	81.69345246
23	620.2817094	62028.17094	0.01	0.99	92732.11556	5024811.433	81.00853784
24	614.0788923	61407.88923	0.01	0.99	91804.7944	4932079.317	80.31670489
25	607.9381034	60793.81034	0.01	0.99	90886.74646	4840274.523	79.61788372

26	601.8587224	60185.87224	0.01	0.99	89977.87899	4749387.776	78.91200376
27	595.8401351	59584.01351	0.01	0.99	89078.1002	4659409.897	78.1989937
28	589.8817338	58988.17338	0.01	0.99	88187.3192	4570331.797	77.47878151
29	583.9829165	58398.29165	0.01	0.99	87305.44601	4482144.478	76.75129446
30	578.1430873	57814.30873	0.01	0.99	86432.39155	4394839.032	76.01640905
31	572.3616564	57236.16564	0.01	0.99	85568.06763	4308406.64	75.27420106
32	566.6380399	56663.80399	0.01	0.99	84712.38696	4222838.573	74.52444552
33	560.9716595	56097.16595	0.01	0.99	83865.26309	4138126.186	73.76711668
34	555.3619429	55536.19429	0.01	0.99	83026.61046	4054260.923	73.00213806
35	549.8083234	54980.83234	0.01	0.99	82196.34435	3971234.312	72.22943239
36	544.3102402	54431.02402	0.01	0.99	81374.38091	3889037.968	71.4489216
37	538.8671378	53886.71378	0.01	0.99	80560.6371	3807663.587	70.66052687
38	533.4784664	53347.84664	0.01	0.99	79755.03073	3727102.95	69.86416856
39	528.1436818	52814.36818	0.01	0.99	78957.48042	3647347.919	69.05976622
40	522.8622449	52286.22449	0.01	0.99	78167.90562	3568390.439	68.2472386
41	517.6336225	51763.36225	0.01	0.99	77386.22656	3490222.533	67.42650564
42	512.4572863	51245.72863	0.01	0.99	76612.3643	3412836.307	66.59747843
43	507.3327134	50733.27134	0.01	0.99	75846.24065	3336223.942	65.76007922
44	502.2593863	50225.93863	0.01	0.99	75087.77825	3260377.702	64.91422143
45	497.2367924	49723.67924	0.01	0.99	74336.90046	3185289.923	64.05981963
46	492.2644245	49226.44245	0.01	0.99	73593.53146	3110953.023	63.1967875
47	487.3417802	48734.17802	0.01	0.99	72857.59615	3037359.491	62.32503788
48	482.4683624	48246.83624	0.01	0.99	72129.02018	2964501.895	61.44448271
49	477.6436788	47764.36788	0.01	0.99	71407.72998	2892372.875	60.55503304
50	472.867242	47286.7242	0.01	0.99	70693.65268	2820965.145	59.65659903
51	468.1385696	46813.85696	0.01	0.99	69986.71616	2750271.492	58.74908993
52	463.4571839	46345.71839	0.01	0.99	69286.84899	2680284.776	57.83241407
53	458.8226121	45882.26121	0.01	0.99	68593.9805	2610997.927	56.90647886
54	454.2343859	45423.43859	0.01	0.99	67908.0407	2542403.947	55.97119077
55	449.6920421	44969.20421	0.01	0.99	67228.96029	2474495.906	55.02645532

56	445.1951217	44519.51217	0.01	0.99	66556.67069	2407266.946	54.07217709
57	440.7431704	44074.31704	0.01	0.99	65891.10398	2340710.275	53.10825969
58	436.3357387	43633.57387	0.01	0.99	65232.19294	2274819.171	52.13460574
59	431.9723814	43197.23814	0.01	0.99	64579.87101	2209586.978	51.15111691
60	427.6526575	42765.26575	0.01	0.99	63934.0723	2145007.107	50.15769385
61	423.376131	42337.6131	0.01	0.99	63294.73158	2081073.035	49.15423621
62	419.1423697	41914.23697	0.01	0.99	62661.78426	2017778.303	48.14064264
63	414.950946	41495.0946	0.01	0.99	62035.16642	1955116.519	47.11681075
64	410.8014365	41080.14365	0.01	0.99	61414.81476	1893081.353	46.08263712
65	406.6934221	40669.34221	0.01	0.99	60800.66661	1831666.538	45.03801729
66	402.6264879	40262.64879	0.01	0.99	60192.65994	1770865.871	43.98284575
67	398.600223	39860.0223	0.01	0.99	59590.73334	1710673.211	42.91701591
68	394.6142208	39461.42208	0.01	0.99	58994.82601	1651082.478	41.84042011
69	390.6680786	39066.80786	0.01	0.99	58404.87775	1592087.652	40.75294961
70	386.7613978	38676.13978	0.01	0.99	57820.82897	1533682.774	39.65449455
71	382.8937838	38289.37838	0.01	0.99	57242.62068	1475861.945	38.54494399
72	379.064846	37906.4846	0.01	0.99	56670.19448	1418619.325	37.42418585
73	375.2741975	37527.41975	0.01	0.99	56103.49253	1361949.13	36.29210692
74	371.5214556	37152.14556	0.01	0.99	55542.45761	1305845.638	35.14859285
75	367.806241	36780.6241	0.01	0.99	54987.03303	1250303.18	33.99352813
76	364.1281786	36412.81786	0.01	0.99	54437.1627	1195316.147	32.82679609
77	360.4868968	36048.68968	0.01	0.99	53892.79107	1140878.984	31.64827888
78	356.8820278	35688.20278	0.01	0.99	53353.86316	1086986.193	30.45785745
79	353.3132076	35331.32076	0.01	0.99	52820.32453	1033632.33	29.25541157
80	349.7800755	34978.00755	0.01	0.99	52292.12128	980812.0055	28.04081977
81	346.2822747	34628.22747	0.01	0.99	51769.20007	928519.8842	26.81395936
82	342.819452	34281.9452	0.01	0.99	51251.50807	876750.6841	25.57470642
83	339.3912575	33939.12575	0.01	0.99	50738.99299	825499.176	24.32293578
84	335.9973449	33599.73449	0.01	0.99	50231.60306	774760.1831	23.05852099
85	332.6373714	33263.73714	0.01	0.99	49729.28703	724528.58	21.78133434

86	329.3109977	32931.09977	0.01	0.99	49231.99416	674799.293	20.4912468
87	326.0178877	32601.78877	0.01	0.99	48739.67422	625567.2988	19.18812808
88	322.7577089	32275.77089	0.01	0.99	48252.27748	576827.6246	17.87184655
89	319.5301318	31953.01318	0.01	0.99	47769.7547	528575.3471	16.54226924
90	316.3348305	31633.48305	0.01	0.99	47292.05715	480805.5924	15.19926186
91	313.1714822	31317.14822	0.01	0.99	46819.13658	433513.5352	13.84268675
92	310.0397673	31003.97673	0.01	0.99	46350.94522	386694.3987	12.47241288
93	306.9393697	30693.93697	0.01	0.99	45887.43576	340343.4534	11.08829584
94	303.869976	30386.9976	0.01	0.99	45428.56141	294456.0177	9.690197814
95	300.8312762	30083.12762	0.01	0.99	44974.27579	249027.4563	8.27797759
96	297.8229634	29782.29634	0.01	0.99	44524.53304	204053.1805	6.851492515
97	294.8447338	29484.47338	0.01	0.99	44079.2877	159528.6474	5.4105985
98	291.8962865	29189.62865	0.01	0.99	43638.49483	115449.3597	3.95515
99	288.9773236	28897.73236	0.01	0.99	43202.10988	71810.86492	2.485
100	286.0875504	28608.75504	0.01	0.99	28608.75504	28608.75504	1
					7453224.877		

Source: computed with excel based on the assumption below

Population of Nigeria as at the year 1990 approximately = 95,000,000 **(f_x)**

Death rate in Nigeria as the year 1990= 18.55%

GDP growth rate as at 1990 = 11.78%

Life expectancy growth rate as at 1990 = 3%.

Assumption: Death rate of 1% reducing balance method after the year 1990.