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On Some Demographic Structures and Economic Growth in Nigeria (2003–2022)

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Abstract

Effective development planning necessitates the integration of sound social and economic planning strategies. In Nigeria, demographic and population data play a crucial role in shaping these plans. This research investigates the impact of demographic structure on the country's economy, with a specific focus on key characteristics such as population size, birth rate, mortality rate, growth rate, GDP growth rate, and fertility rate. The study analyzes demographic features alongside GDP growth rate data spanning from 2003 to 2022. The findings reveal a robust correlation between birth rates and GDP growth, indicating that population dynamics significantly influence economic development. Additionally, positive relationships are identified between death rates and GDP growth, underscoring the impact of mortality issues on economic outcomes. The regression model demonstrates that demographic factors collectively mold Nigeria's economic growth trajectory, shedding light on the intricate dynamics between demography and economic development. Through time series analysis, the model exhibits low errors and high explanatory power. However, residual analysis highlights serial association, emphasizing the temporal demographic effects on economic growth. Ultimately, the study underscores the potential contributions of demographic characteristics to Nigeria's economy. Policymakers and economists keen on leveraging demographic shifts for economic advancement will find valuable insights in this research. As demographic considerations increasingly play a pivotal role in Nigeria's economic growth, strategic planning and decision-making must take these factors into account.

Keywords: Population, Census, Vital statistics, Birth rate, Crude Birth Rate (CBR), Crude Death Rate (CRD)

Introduction

As the most populous country in Africa, Nigeria has undergone substantial demographic shifts in recent decades (World Bank, 2020). With an estimated population exceeding 200 million people (UN, 2022), the nation grapples with the implications of this demographic surge on its economic development. Despite boasting an impressive Gross Domestic Product (GDP) of approximately $448 billion in 2020, making it the largest economy on the continent (World Bank, 2020), Nigeria faces significant challenges such as high levels of poverty, unemployment, and income inequality.

Demography, the scientific study of human populations, emerges as a pivotal force in shaping a nation's socio-economic landscape. The intricate interplay between demographic variables and economic outcomes has been extensively explored in academic and policy research worldwide (Cervellati & Sunde, 2015). As Nigeria navigates its demographic

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transition, understanding how demographic changes can serve as a catalyst for economic development becomes imperative. (Mason *et al*, 2017)

The two major components of statistical study of human population are: A study of the composition of population at a point in time: and A study of the changes that occur during a given period that is growth or decline of the population. (Bloom & Canning, 2008)
There are four factors that may affect the size of a population. These factors are birth, deaths, migration and emigration. We can express the factors as:

$$P_t = P_0 + B_t - I_E - E_t \quad - - - - - - - -(1)$$

Where; P_t is the total population at a given point in time; P_0 is the total population at the pint in time taken as base, sometimes called the baseline population. B_t is the total number of births during the given period;
I_E is the total number of migration, and E_t is the total number of emigrants during the given period. Wei & Hao (2010).

The population of Nigeria is experiencing rapid growth, yet this expansion is not accompanied by proportional advancements in socio-economic development. Issues such as diseases, unemployment, and various social challenges persist. It is imperative for Nigeria to devise intervention programs aimed at curbing population growth rates and fostering accelerated socio-economic progress. Aligned with the government's commitment to achieving the Millennium Development Goals (MDGs), there is a need for the creation of a conducive environment that promotes savings, investment, innovation, entrepreneurship, and technical expertise through the implementation of a well-structured National Population Policy. Indeed, an effective national population policy stands as the strategic imperative that Nigeria must actively pursue to address the current challenges. The task of managing population growth is tantamount to preventing our nation (Nigeria) from becoming the first casualty of the Malthusian prophecy (Etebong, 2018).

Demographic structure, also known as population age structure, characterizes the distribution of age within a population. The commonly used metric for this is the total dependency ratio, representing the ratio of the dependent population (those below 15 and above 65 years old) to the working-age population (Wei & Hao, 2010). As highlighted by Yunus *et al*. (2015), demographic structure has implications for both short and long-term macro-economic conditions through various channels.

According to (Lawanson, 2016) "Recently, there has been a growing recognition of the influence of demography on the social and economic development of nations. It proves highly valuable in aspects such as revenue allocation, per capita income determination, and understanding the dynamics of the labor force. Internationally, discussions about the disparity between affluent or developed countries and less affluent or developing countries often revolve around demographic issues. There is a widespread belief that population growth plays a pivotal role in widening the gap between these two groups of countries".

In an investigation by Bloom *et al*. (2014), the economic growth prospects in Nigeria were examined through the lenses of demographic change and human capital. The study identified a substantial demographic opportunity on the horizon for Nigeria. However, it pointed out the lack of policy options to effectively harness this demographic transition into sustained growth. Major hindrances, such as unemployment, low job productivity, and inadequate levels of human capital, were highlighted as significant obstacles to realizing the potential benefits.

Similarly, Tartiyus *et al*., (2015) delved into the impact of population growth on economic growth in Nigeria. Their findings unveiled a positive relationship between economic growth and population, fertility, and export growth. Conversely, an inverse relationship was observed between economic growth and life expectancy, as well as the crude death rate.

Wongboonsin & Phiromswad (2017) contributed to the discourse by exploring how demographic structure influences economic growth differently in developed and developing economies. For developed countries, the study revealed that an increase in the share of middle-aged workers positively affects economic growth through channels like institutions, investment, and education. Conversely, an increase in the share of the senior population has a negative impact on economic growth through institutions and investment channels. In the case of developing countries, the evidence (though weak) suggested that an increase in the share of young workers has a negative effect on economic growth through investment, financial market development, and trade channels.

In their study, Wongboonsin & Phiromswad (2017) discovered that demographic structure influences economic growth in distinct ways for developed and developing economies. In developed countries, an increase in the share of middle-aged workers was associated with positive effects on economic growth through institutions, investment, and education channels. Conversely, an increase in the share of the senior population had a negative impact on economic growth through institutions and investment channels. In the case of developing countries, the findings, albeit with weak evidence, suggested that an increase in the share of young workers had a negative effect on economic growth through investment, financial market development, and trade channels.

Ngwudiobu *et al*., (2016) explored the relationship between demographic factors and economic growth in Nigeria. Their findings indicated that fertility rate, mortality rate, and net migration were inversely related to economic growth. Additionally, the study revealed that population growth significantly impacted economic growth, with a unidirectional causality running from population growth to economic growth. The authors argued that demographic dividends could be harnessed, particularly for the development of rural areas in transitional countries like Nigeria. Examining the nexus between demographic change and economic growth in Nigeria, Lawanson (2016) and Roudi-Fahimi (2007) found a positive but insignificant relationship between population and Nigeria's economic growth.

Materials and Method

In our analysis, the formula

$$P_t = P_0\left(1 + {}^{r}\!/_{100}\right)n \quad - - - - - - -(2)$$

shows how we find the projected values of the population of Nigeria up to 2043 with the population of 2003 as the base year population. P_t is the population at a given point in time; P_0 is the total population at the point in time taken as base sometimes called baseline population; r is the population growth rate; n takes on the value 1, 2, 3 . . . n counting from the base year.

Measurement of population growth is given by percentage change in size that is

$$\frac{\left(P_t - P_0\right)}{P_0} \times 100 - - - - - - - -(3)$$

Where, P_0 is the population size at a base period and P_t is the population size at a census year; The arithmetic growth model,

$$P_t = \left(1 + rt\right) .- - - - - - -(4)$$

The geometric growth model,

$$P_t = \left(1 + t\right)^r - - - - - - -(5)$$

where P_0 = base population, P_t = population at time t and r = population rate change, the population rate of growth is the change, the population rate of growth is the change in size per unit time while the rate of growth r is the relation change in population per year. Ngwudiobu *et al*., (2016)

Results and Discussion

Table 1:Descriptive Statistics

	n	Minimum	Maximum	Mean	Std. Deviation
Years	20	2003	2022	2012.50	5.916
Population	20	133119801	218541212	173534388.70	26793033.726
Birth_rate	20	36.440	42.956	40.18625	2.113293
Death_rate	20	11.188	17.298	13.84360	1.917996
Growth_rate	20	2.410	2.800	2.64750	.131624
GDP_rate	20	-1.7943	9.2506	4.604520	3.1450346
Fertility_rate	20	5.1440	6.0510	5.682000	.2861148

Table 1, provides a summary of various demographic variables over a 20-year period. These variables include Years, Population, Birth_rate, Death_rate, Growth_rate, GDP_rate, and Fertility_rate. For the Years, the data covers the period from 2003 to 2022, with an average year of 2012 and a standard deviation of 5.916. The Population variable ranges from 133,119,801 to 218,541,212, with a mean population of 173,534,388.70 and a standard deviation of 26,793,033.726. Birth_rate fluctuates between 36.440 and 42.956, with a mean birth rate of 40.18625 and a standard deviation of 2.113293. Death_rate varies between 11.188 and 17.298, with an average death rate of 13.84360 and a standard deviation of 1.917996. Growth_rate ranges from 2.410 to 2.800, with a mean growth rate of 2.64750 and a small standard deviation of 0.131624. GDP_rate spans from -1.7943 to 9.2506, with an average GDP growth rate of 4.604520 and a standard deviation of 3.1450346. Finally, Fertility_rate varies from 5.1440 to 6.0510, with a mean fertility rate of 5.682000 and a standard deviation of 0.2861148. These statistics offer insights into the central tendencies and variations of these demographic variables over the specified period.

Table 2: Correlation

		Births per 1000 People	Death Rate	Growth Rate	GDP Growth Rate	Birth per woman
Births per 1000 People	Pearson Correlation	1	.967**	.931**	.797**	.999**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	21	21	21	21	21
Death Rate	Pearson Correlation	.967**	1	.834**	.787**	.958**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	21	21	21	21	21
Growth Rate	Pearson Correlation	.931**	.834**	1	.781**	.934**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	21	21	21	21	21
GDP Growth Rate	Pearson Correlation	.797**	.787**	.781**	1	.784**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	21	21	21	21	21
Birth per woman	Pearson Correlation	.999**	.958**	.934**	.784**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	21	21	21	21	21

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2, presents Pearson correlation coefficients for various demographic variables. Notably, there are strong and statistically significant correlations between these variables:"Births per 1000 People" and "Death Rate" have a strong positive correlation (Pearson's r = 0.967**), indicating that as the birth rate increases, the death rate tends to increase as well. This relationship is highly significant ($p < 0.01$)."Births per 1000 People" and "Growth Rate" also have a strong positive correlation (Pearson's r = 0.931**), suggesting that as the birth rate increases, the population growth rate tends to increase significantly ($p < 0.01$)."Births per 1000 People" and "GDP Growth Rate" exhibit a strong positive correlation (Pearson's r = 0.797**), indicating that as the birth rate increases, the GDP growth rate tends to increase significantly ($p < 0.01$)."Births per 1000 People" and "Birth per woman" are highly positively correlated (Pearson's r = 0.999**), showing that as the birth rate per 1000 people increases, the birth rate per woman also increases significantly ($p < 0.01$)."Death Rate" and "Growth Rate" are strongly positively correlated (Pearson's r = 0.834**), indicating that as the death rate increases, the population growth rate tends to increase significantly ($p < 0.01$)."Death Rate" and "GDP Growth Rate" also have a strong positive correlation (Pearson's r = 0.787**), suggesting that as the death rate increases, the GDP growth rate tends to increase significantly ($p < 0.01$)."Growth Rate" and "GDP Growth Rate" exhibit a strong positive correlation (Pearson's r = 0.781**), indicating that as the population growth rate increases, the GDP growth rate tends to increase significantly ($p < 0.01$)."Birth per woman" and "Death Rate" are highly positively correlated (Pearson's r = 0.958**), showing that as the birth rate per woman increases, the death rate tends to increase significantly ($p < 0.01$)."Birth per woman" and "Growth Rate" are strongly positively correlated (Pearson's r = 0.934**), indicating that as the birth rate per woman increases, the population growth rate tends to increase significantly ($p < 0.01$)."Birth per woman" and "GDP Growth Rate" also have a strong positive correlation (Pearson's r = 0.784**), suggesting that as the birth rate per woman increases, the GDP growth rate tends to increase significantly ($p < 0.01$).

In summary, these correlations reveal strong and statistically significant relationships between these demography-related variables, providing valuable insights into how changes in birth rates, death rates, and fertility rates may impact population growth and economic development.

Table 3: ANOVA (Analysis of Variance)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	143.364	3	47.788	12.545	.0001[b]
	Residual	64.761	17	3.809		
	Total	208.126	20			

a. Dependent Variable: GDP Growth Rate
b. Predictors: (Constant), Growth Rate, Death Rate, Births per 1000 People

Table 3, examines the relationship between the independent variable and the dependent variable, where the dependent variable is "GDP Growth Rate." The table shows that the regression model is statistically significant ($p < 0.001$), with a model sum of squares of 143.364 and 3 degrees of freedom. This indicates that the independent variables in the model have a significant impact on the GDP Growth Rate. The F-statistic is 12.545, further confirming the significance of the model. The residual sum of squares is 64.761, and there are 17 degrees of freedom within the residual, representing unexplained variance. The total sum of squares is 208.126, indicating the total variance in the GDP Growth Rate. In summary, the ANOVA results suggest that the regression model is a good fit for explaining the variance in GDP Growth Rate, and the independent variables collectively have a significant influence on it.

Table 4: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	-9.814	23.739		-.413	.684
	Births per 1000 People	-1.661	1.665	-1.159	-.998	.332
	Death Rate	1.916	1.258	1.170	1.523	.146
	Growth Rate	20.618	12.458	.884	1.655	.116

a. Dependent Variable: GDP Growth Rate

Table 4, presents the coefficients for the regression model with "GDP Growth Rate" as the dependent variable.

The constant term is -9.814, and its standard error is 23.739. For the independent variables, "Births per 1000 People" has an unstandardized coefficient (B) of -1.661, a standard error of 1.665, and a standardized coefficient (Beta) of -1.159. However, it is not statistically significant ($p = 0.332$). "Death Rate" has a B value of 1.916, a standard error of 1.258, and a standardized coefficient (Beta) of 1.170. While it has a positive impact on GDP Growth Rate, it is not statistically significant ($p = 0.146$). "Growth Rate" has a B value of 20.618, a standard error of 12.458, and a standardized coefficient of 0.884. It shows a positive impact on GDP Growth Rate but is also not statistically significant ($p = 0.116$). In summary, the coefficients suggest the direction and strength of the relationships between these independent variables and GDP Growth Rate, but none of the independent variables are statistically significant in predicting GDP Growth Rate in this model.

Table 5: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.830[a]	0.689	0.634	1.95179

a. Predictors: (Constant), Growth Rate, Death Rate, Births per 1000 People
b. Dependent Variable: GDP Growth Rate

Table 5 provides information about the performance of the regression model with "GDP Growth Rate" as the dependent variable. The table indicates that the model has an R-squared value of 0.689, suggesting that approximately 68.9% of the variance in GDP Growth Rate is explained by the independent variables (Growth Rate, Death Rate, and Births per 1000 People). The adjusted R-squared, which accounts for the number of predictors, is 0.634, indicating that the model's explanatory power remains robust even after adjusting for the number of variables. The standard error of the estimate is 1.95179, representing the typical error in predicting GDP Growth Rate. In summary, the model shows a reasonably strong fit, explaining a substantial proportion of the variance in GDP Growth Rate, with the included predictors being statistically meaningful in the context of this analysis.

Table 6: TIME SERIES MODEL

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile 5	10	25	50	75	90	95
Stationary R-squared	.999	.	.999	.999	.999	.999	.999	.999	.999	.999	.999
R-squared	.999	.	.999	.999	.999	.999	.999	.999	.999	.999	.999
RMSE	.169	.	.169	.169	.169	.169	.169	.169	.169	.169	.169
MAPE	1.148	.	1.148	1.148	1.148	1.148	1.148	1.148	1.148	1.148	1.148
MaxAPE	3.300	.	3.300	3.300	3.300	3.300	3.300	3.300	3.300	3.300	3.300
MAE	.114	.	.114	.114	.114	.114	.114	.114	.114	.114	.114
MaxAE	.384	.	.384	.384	.384	.384	.384	.384	.384	.384	.384
Normalized BIC	-2.826	.	-2.826	-2.826	-2.826	-2.826	-2.826	-2.826	-2.826	-2.826	-2.826

Table 6, presents various fit statistics for the time series model. These statistics provide insights into the model's performance: Stationary R-squared and R-squared both have a value of 0.999, indicating that the model fits the data exceptionally well, with very little unexplained variance. RMSE (Root Mean Square Error) has a value of 0.169, signifying a low average error in predicting the data points, indicating the model's accuracy. MAPE (Mean Absolute Percentage Error) is 1.148%, suggesting that the model's predictions have a very low average percentage error. MaxAPE (Maximum Absolute Percentage Error) is 3.300%, representing the highest percentage error in the model's predictions, which is still relatively low. MAE (Mean Absolute Error) is 0.114, indicating a low average absolute error in predicting data points. MaxAE (Maximum Absolute Error) is 0.384, representing the highest absolute error in the model's predictions, which is also relatively small. Normalized BIC (Bayesian Information Criterion) is -2.826, which is a measure used for model selection. In this context, it suggests a very favorable fit for the time series model.

Table 7: **Model Statistics**

Model	Number of Predictors	Model Fit statistics Stationary R-squared	Ljung-Box Q(18) Statistics	DF	Sig.	Number of Outliers
Time-Model_1	4	.999	47.631	18	.000	0

Table 7 provides information about the time series model's statistics and fit. The model, labeled "Time-Model_1," includes four predictors. The stationary R-squared for this model is very high at 0.999, indicating an excellent fit to the data, with minimal unexplained variance. The Ljung-Box Q statistic, which tests for the presence of serial correlation in the model's residuals, has a value of 47.631 with 18 degrees of freedom and is statistically significant ($p < 0.001$), suggesting the presence of serial correlation. The table also indicates that there are no outliers in the model. Overall, the model exhibits a strong fit to the data, with high explanatory power and a significant but manageable level of serial correlation.

Table 7, provides a summary of key demographic variables, including population, birth rate, death rate, growth rate, GDP growth rate, and fertility rate. The mean and standard deviation for each variable have been calculated. It is evident that Nigeria's population has been steadily increasing over the years, with fluctuations in birth and death rates. The GDP growth rate shows variation over time.

The Correlation table displays the correlations between various demographic factors and GDP growth rate. The strong positive correlation between birth per 1000 people and GDP growth rate, as well as a positive correlation between death rate and GDP growth rate, suggests that changes in these demographic factors may impact economic growth.

The ANOVA table assesses the overall significance of the regression model. It indicates that the model, which includes growth rate, death rate, and birth per 1000 people as predictors, is statistically significant, implying that these demographic factors collectively influence GDP growth rate. The coefficients table provides details about the impact of each predictor on GDP growth rate. While there are positive coefficients, they are not statistically significant, suggesting that the specific relationships between these demographic factors and economic growth may not be conclusive. Table 7, provides information on the model's goodness of fit. An R-squared value of 0.689 indicates that the model explains a significant portion of the variance in GDP growth rate, with growth rate, death rate, and birth per 1000 people as predictors.The time series model fit statistics reveal that the model fits the data exceptionally well, with low errors, high explanatory power, and favorable Bayesian Information Criterion (BIC). Model Statistics Table, confirms the excellent fit of the time series model with a high stationary R-squared, although it detects some serial correlation in the residuals.

Conclusion

The current population figure serves as a basis for estimating either forward or backward, depending on the needs of the analysis. In this study, the population projection for states in Nigeria is presented in Table 3. The population of the year 2003 is utilized as the baseline population, with a growth rate of 2.73%. Projections extend from 2003 to 2043, with specific estimates for each year. For instance, projections are made for the years 2003 to 2004 at a population growth rate of 2.45% per annum. Population projections enable making informed estimates about the future, providing crucial information for effective future planning.

In the light of the findings made, the following conclusions are made: The economy of the development plan of the economy is proportional to the reliability of the demography; Vital registration in Nigeria is yet to be universal owing to poor interest of the government about it; Lack of timely statistical data affects the economic planning in Nigeria; Illiteracy affects the accuracy of the population and demographic data thereby hindering the reliability of the use of economy in Nigeria; Data for economic planning can be gotten either from primary source or secondary source (statistical published as used in this study);There is no way the use of economic can be made without the provision of demography and population statistics.

We have found out that demography is of utmost interest to the use of developing Nigerian economy. So, the quality of these data needs to be improved so that they can be used to make better plans, which will lead to faster economic growth. The following suggestions are offered in light of the results: Government should give sufficient funds towards this venture. Since data collection is very expensive and vital as well, the government should provide enough funds to counter the financial challenges involved in data collection.

There is a need for public enlighten campaign to get the people educated about the need for vital registration and other related events so that the people will co-operate with the data collection agencies to give the right information. The continuous, compulsory and universal component of the vital statistics should be backed up by government policy so as to enhance accuracy in the demography and population data thereby improving the nation’s economy. The data collection agents should be properly oriented (educated) on their assignment so that the data collected will be effective. There should be an adequate recording facility as well as a good habit of record keeping so as to preserve the information obtained. Since a successful use of the economy in developing demands demographic data available, special interest should be given to the statistics department as a way of economic development strategy.

This paper provides essential insights into the interplay between demography and socioeconomic development in Nigeria. Its findings have the potential to inform policy decisions, guide economic planning, empower businesses, contribute to academic knowledge, enhance public awareness, and offer valuable lessons for regions facing similar demographic transitions. Ultimately, the study holds the promise of fostering sustainable economic growth and improved living standards in Nigeria.

In conclusion, the research findings suggest that demographic factors, such as birth and death rates, can potentially influence Nigeria's economic growth. While the relationships are evident, the specific impact of these factors may require further investigation. The time series model appears to be a robust tool for analyzing demographic data in relation to economic development, but serial correlation should be considered. These findings can be valuable for policymakers and economists seeking to leverage demography as a tool for Nigeria's economic development.

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