EFFECTS OF CRUDE BIRTH RATE ON ECONOMIC GROWTH IN NIGERIA

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ABSTRACT
This paper explores Nigeria's crude birth rate relationship with her economic growth based on time-series information spanning 1970 to 2019, sourced from the Nigerian Bureau of Statistics, the Central Bank, the World Bank and other relevant agencies.The variables adopted unit roots and cointegration while the two-stage least squares (2SLS) estimation technique was adopted in the analysis. They were all of order one and the result showed a cointegration among them. The 2SLS results showed significant positive relationships between crude birth rate and per-capita income, while an inverse relationship was found to exist between literacy rate and crude birth rate. Results also showed that literacy rate and total labour participation spurred the per capita income of Nigeria. And the paper concludes that the literacy rate is an important policy instrument that can lower the birth rate and raise per capita income in Nigeria.
KEYWORDS: Crude Birth, Literacy Rate, 2SLS, Economic Growth.

JEL Codes: J13, C32 041

1. INTRODUCTION

The classical economic population growth theory as postulated by Malthus (1798) stated that a rise in incomes, particularly among any nation's poorer classes, tends to increase fertility rates but decrease mortality rates. Events since Malthus' time have not only negated that theory but has also led to the gradual development of the theory of demographic transition. The theory is backed by the hypothesis that man's reproductive behaviour is highly responsive to his environment, and it typically relates a trend of birth and death rates to a country's economic development.

In a typical agrarian peasant economy, characterized by a high degree of self-sufficiency and a relatively slow change in production techniques, birth and death rates are very high. While the birth rates may remain high and fairly stable in such a circumstance, the death rates respond immediately to fluctuations in nutrition, sanitation, and availability of effective preventive and curative medical practices. High birth rates are traditionally associated with social beliefs and customs and the feeling that large numbers of births are an economic advantage to a peasant family. For instance, it is often held that in a predominantly agrarian economy, the benefits of having children are derived from the utility received from enjoying them as a consumption good, from the income received by them working in a productive capacity for the family and the potential security of receiving support and assistance from progeny in old age (Diejomaoh, 1965)

Further, religious and communal laws impact population growth which contradicts the "axiom of moral restraint" propounded by Malthus. The impact of population outweighs food problems in Nigeria and the

consequences include population congestion, high dependency ratio, increasing social and economic problems among others. Therefore, to prevent or control these menace, which may manifest in widespread poverty and other socio-economic imbroglios, appropriate policies should be put in place.

A lot of empirical studies have shown recent scholarly attempts to estimate, at least in broad terms, the impact demographic factors could exercise on an economy given reliable data(Esping-Andersen and Billari 2015; Goldscheider et al. 2015 and Lesthaeghe 2010).
However, for analytical purposes, the implications of rapid population growth can be classified into two components: those which occur in the long run and those which primarily arise in the short run as the rate of population growth changes. The long-run burden of rapid population growth, from the economic standpoint, is its constraining effect on the rate of structural transformation needed to raise labour productivity and personal income in a dual economy.

In the short run, variations in population growth rate can impose immediate burdens on the family and society at large; their precise nature and extent, however, will depend on the cause of changes as well as their impact on the structure of the population's age distribution. Besides creating the dependency burden, changes in fertility patterns also affect the size of the labour force long before they alter the population of people old enough to work. In addition, any changes in family size and age composition affect per capita incomes associated with any given total output and thus may have immediate implications for consumption, total demand, and capital formation (Daniel et al, 1975).

With a 2.5 annual growth rate, Nigeria is known to have a rapidly growing population (World Bank, 2020). The population is getting fairly large relative to the available resources of the country. The rather hastening pace of urbanization which follows in the wake of rapid population growth has imposed both personal and social costs on the economy.
The population is one of the most important factors in economic growth and the speed of its growth determines its size. Weil (2013) stated that "rapid growth in population causes a country to be poor, that something about being poor leads to rapid population growth or that causality runs in both directions". Understanding the relationships between the rate of fertility and economic growth have great significance in making corresponding economic and population policies and promoting long-term economic development.
It was particularly interesting to study the relationship because this is when a lack of financial resources means a country cannot stabilize its population growth and is unable to deal effectively with a range of threats which include natural and artificial disasters.
While findings, as regards the effects of population growth on economic growth based on empirical studies, are mixed, some studies such as Adewole (2012), Shaari, Rahim and Rashid (2013) and Tartiyus, Dauda and Peter (2015) found population growth to have positive effects on economic growth, the adverse implications of the rising population for economic growth is on account of poverty. Population growth may negatively affect economic growth. However, studies such as Dao (2012) and Okwori, Ajegi, Ochinyabo, and Abdullahi et al (2015) argue that population growth has no significant effect on economic growth.
Also, some studies from available works of literature taking an aggregate approach to the effects of population on economic outcomes dealt adequately with the issue of identification. The determinants of population growth, most notably fertility, are endogenous variables. Changes in infertility are not only themselves affected by economic outcomes, but they are also affected by unobserved variables that may also have direct effects on the economy. These could include the illiteracy rate, total labour force, wage rate, and cultural outlook. Because of these issues of omitted variables and reverse causation, the ability to draw inferences from the conditional correlations in growth regressions may be weak. Several studies have attempted to circumvent the identification problem in the macroeconomic context using instrumental

variables. Therefore, the objective of this study is to ascertain the relationship between the crude birth rate and economic growth in Nigeria.

The paper is structured into five subheads which includes an introductory section, review of literature, methods, results and discussions and conclusion.

2. LITERATURE REVIEW

A review of literature on population and economic growth suggests that some studies have been performed in Nigeria and other countries of the world. The best known early aggregate analysis of the relationship between population growth and development by Kuznets (1967). His study found a positive correlation between the growth rate of population and income per capita within broad country groupings, which he interpreted as evidence of a lack of a negative causal effect of population growth on income percapita, contrary to the prevailing view at the time.

2.1Theoretical Review

This study is based on Malthusian thoughts and Population Theory is the idea that the capacity of human populations to reproduce is (in principle) unlimited and proceeds with a geometric ratio, whereas the capacity to produce the means of subsistence is necessarily limited and increases at best in arithmetic fashion (Malthus, 1976). This theory reveals how rapid population growth hinders economic development in a country. This is a typical problem in the economy of Nigeria where the country's large population results high rate of unemployment and underemployment, an increase in crime rate and insecurity, poverty, among others. Thus, the Malthusian population trap contends that rapid population growth leads to economic crises in a nation (Nyoni&Bonga, 2017).

2.2Empirical Literature

In their study on the Chinese economy, Gao and Shao (2016) analysedthe impact of opulation transition in China provinces on economic growth. The result supports the demographic dividend hypothesis.
Nyoni (2018) examined the determinants of population growth in Pakistan from 1960 to 2017. Using the ordinary least squares technique, the study indicated that a 1% increase in contraceptive prevalence rate, life expectancy at birth andinfant mortality decrease in population growth in Pakistanwhile a 1% increase in unemployment, total fertility rate andper capita income increase population growth in Pakistan.

Dominic et al (2017) inspected the factors influencing Nigerians population growth. Time series variables such as population growth rate, GDP per capita, infant mortality rate, maternal mortality rate, human development index, proportion-of-labour-force employed were used in the study.

Singh, Mittal, Sharma, Smarandache (2017) examined the determinants of population growth in Rajasthan (India) and concluded that there are lots of demographic and socio-economic factors accountable for the growth of population and these comprise of death rate, crude birth rate, and crude death rate among others.

Wongboonsin and Phiromswad (2017) found that demographic structure affects economic growth differently in developed and developing economies. For developed countries, they found that an increase in the share of middle-aged workers has a positive effect on economic growth through institutions, investment and education channels. On the other hand, an increase in the share of the senior population has a negative effect on economic growth through institutions and investment channels. For developing countries, they found (but with weak evidence) that an increase in the share of young workers has a negative effect on economic growth through investment, financial market development and trade channels.

Aidi, Emecheta and Ngwudiobu (2016) found that fertility rate, mortality rate and netmigration are inversely related to economic growth in Nigeria. Similarly, Nwosu, Dike and Okwara (2014) found that population growth has a significant impact on economic growth; and there is a unidirectional causality running from population growth to economic growth.Akokuwebe and Okunola (2015) argued that demographic dividends can be harnessed for the development of especially rural areas in transitional countries like Nigeria. Adenola and Saibu (2017) examined the relationship between demographic change and economic growth in Nigeria. They found that the population has a positive but insignificant relationship with Nigeria's economic growth.

Tartiyus, Dauda and Peter (2015) evaluated the impact of population growth oneconomic growth inNigeria from 1980 to 2010 given that the impact of populationgrowth on economic growth has always been a subject of disagreement amongeconomists and given Nigeria's high rate of population growth. The data were analyzedusing descriptive statistics as well as regression analysis. The result revealed that there isa positive relationship between economic growth (proxy by GDP growth) and population,fertility and export growth while negative relationships werefound between economicgrowth (proxy by GDP growth) and life expectancy, and crude death rate. It wasrecommended among others that the average population growth rate of Nigeria should bemaintained since it is found to impact positively on economic growth in Nigeria withinthe period of study and that measures should be adopted to check the crude death rate ofNigeria as it affects economic growth negatively.

Considering the case of Mexico, Garza-Rodriguez, Andrade-Velasco, Martinez-Silva, Renteria-Rodriguez and Vallejo-Castillo (2016) analyzedthe dynamic relationship between population growth and economic growth, through a structural break cointegrationanalysis for the period 1960-2014.The Gregory-Hansen cointegration test confirmed the existence of long-run equilibrium. Based on the results of this test, using 1985 as theyear in which the structural break occurs in the cointegrating equation and therefore theinclusion of a dummy variable for this year in the VECM developed in the paper, resultsobtained suggested that in the short run, economic growth has a negative effect on population growth, while in the long run, the population has a positive effect on per capitaGDP and per capita GDP also positively affects the population. However, Aidi et al (2016) using more recent data investigated the relationship between population growth and economic growth in Nigeria.The researchers employed Granger- causality technique for the study and found that neither population the growth Granger-Cause economic growth nor economic growth Granger-Cause population during the period understudy (i.e. 1970 to 2013). This finding is therefore in stark contrast to that of Nwosu et al (2014).
However, the argument by few studies including Shah, Sargani, Ali and Siraj (2015) and Guga, Alikaj and Zeneli (2015) that populationgrowth may have a negative effect on economic growth should be taken seriously.Thisis so as population growth is argued to contribute to unemployment, poverty environmentalproblems (such as rising levels of atmospheric carbon dioxide, biologicaldiversity loss, global warming, and pollution) and other social ills, and through theseeconomic growths will suffer a decline. The further finding of a long-run relationshipbetween population growth and economic growth as found by some studiesperforming cointegration tests further suggests the need for consideration of theimplications of population growth for economic growth over the long term.

3. METHODOLOGY

Barro (1991) provides a theoretical framework for incorporating fertility (or population growth) in models of economic growth. In addition, his neoclassical growth model contains, as basic arguments, human capital investment and technological change. In this study, we modelled crude birth rate and economic growth within a simultaneous equation framework. This is because proper analysis of the relationship between, crude birth rate and economic growth would, at best, be done within a simultaneous equation framework to allow for the expected bi-directional causation amongst the variables.This is a significant departure from

related studies that have adopted single-equation models to examine this relationship. The study utilizes two equations: economic growth and crude birth rate. In the economic growth equation, income per capita is assumed to depend on crude birth rate, illiteracy rate, wage rate and lagged income per capita. The crude birth rate is assumed to be a function of income per capita, illiteracy rate, total labour force participation rate, wage rate and lagged crude death rate.

The study uses annual data from 1970 to 2019 for Nigeria. The data to be used for the analysis are secondary data as published and freely made available by the National Bureau of Statistics and the Central Bank of Nigeria. The complementary source includes the World Bank Africa Development Indicator. Due to the issue ofendogeneity and the possibility of reverse causation, we propose to use simultaneous equation techniques: 2SLS. Thus, the 2SLS estimator is used to (i) account for the simultaneity bias between economic growth and crude birth rate variables and (ii) control for the probable existence of cross error correlation resulting from the simultaneity between the economic growth and crude birth rate variables. The 2SLS is particularly efficient in the presence of endogeneity bias given appropriateinstrumentation.

3.1Model Specification

Following Asterious and Hall (2007) and Hyndman and Athanasopolous (2013), introducing logarithms help provide stability to the time series data variance. Using the Cobb-Douglas production function, we can construct a Solow model which includes education:
The empirically estimable log-linear form of the model with minor modification is stated as:

$$LnGdppc = \phi_0 + \phi_1 InCBR + \phi_2 InILR + \phi_3 InRWR + \phi_4 GDPPC_{-1} + \mu t \quad (1)$$

$$LnCBR = \alpha_0 + \alpha_1 InGDPPC + \alpha_2 InILR + \alpha_3 InRWR + \alpha_4 InCBR + \alpha_5 InTLF + \mu t \quad (2)$$

Where,
CBR= crude birth rate; gdppc = income per capita; ILR = illiteracy rate; CBR_{-1} = lagged crude birth rate; TLF = total labour force participation rate; RWR = wage rate; and $GDPPC_{-1}$= lagged income per capita.

4 RESULTS AND DISCUSSIONOF FINDINGS

4.1. Descriptive Analysis

Table 1presents the variables used in the estimation and their characteristics. The Jarque-Bera statistic rejects the null hypothesis of normal distribution for illiteracy rate (ILR) and real wage rate (RWR). On the other hand, the null hypothesis of the normal distribution is accepted forcrude birth rate (CBR), income per capita (GDPPC) and total labour force participation rate (TLF) and illiteracy rate (ILR). Also, while the distribution of ILR AND RWR is leptokurtic, those of CBR, GDPPC, and TLF are platykurtic.

Table 1: *Descriptive Statistics of Variables*

Metrics	LCBR	LGDPPC	ILR	LRWR	LTLF
Mean	3.77169	6.73561	16.5481	9.28847	17.4148
Median	3.77159	6.49566	16.7056	9.35486	17.4122
Maximum	3.856	8.03883	17.168	10.7693	17.9622
Minimum	3.61092	5.07673	15.0728	6.96523	16.8342
Std. Dev.	0.06729	0.80301	0.54354	0.80672	0.33369
Skewness	-0.6306	0.02611	-1.2399	-0.9784	-0.0744
Kurtosis	2.64014	1.91114	3.80125	4.27744	1.77874
Jarque-Bera	3.65506	2.52525	14.4315	11.6049	3.21645
Probability	0.16081	0.28291	0.00074	0.00302	0.20024

Source: Authors computation using E- view 9

Testing for Stationary

In economic literature, most macroeconomic time series data are non-stationary, and employing such non-stationary variables in empirical investigations might produce spurious results and, by extension, misleading policy prescriptions (Granger&Newbold, 1977). As such, we investigated the time-series properties using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, and the results are as presented in tables 2 and 3, respectively. The results show that all variables used in the study areI(1)variables, that is, stationarity was attained after the first difference in both the ADF and PP test procedures.

Table 2: *Augmented Dickey-Fuller (ADF) Unit Root Tests*

Variables	ADF @ level	Critical value @5%	ADF @1st Difference	Critical value @ 5%	Order of integration
LCBR	-2.3131	-2.9212	-3.4204	-2.9224	1(1)
LGDPPC	-1.4033	-2.9212	-5.5713	-2.9224	1(1)
LILR	-2.1943	-2.9212	-6.8061	-2.9224	1(1)
LRWR	-2.1943	-2.9212	-6.7473	-2.9224	1(1)
LTLF	-1.0816	-2.9212	-4.7064	-2.9224	1(1)

Source: Authors computation using E- view 9

Table 3:*Phillips-Perron (PP) Unit Root Tests*

Variables	PP @ level	Critical value @5%	PP @1st Difference	Critical value @ 5%	Order of integration
LCBR	-2.797	-2.9212	-1.9588	-2.9224	1(1)
LGDPPC	-1.474	-2.9212	-5.7269	-2.9224	1(1)
LILR	-2.2991	-2.9212	-6.895	-2.9224	1(1)
LRWR	-2.2064	-2.9212	-6.7426	-2.9224	1(1)
LTLF	-1.0186	-2.9212	-4.0942	-2.9224	1(1)

Source: Authors computation using E- view 9

Testing for Cointegration

Cointegration tests are designed to test for the existence of a long-run equilibriumbetween the variables in the model, as this is vital for policymaking.To ascertain the existence or otherwise of a stable long-run relationship among the variables under focus, this study adopts the methodology developed by Johansen (1988), and Johansen and Juselius (1990). This approach is expected to produce asymptotically optimal estimates because it incorporates a parametric correction mechanism, and it does not depend on the methods of normalization chosen. Following the approach by Johansen and Juselius (1990), two likelihood test statistics, the Max-Eigen and Trace tests were utilized to derive the number of cointegrating vectors. The cointegrating tests were performed allowing the absence of linear trends.

From the cointegration results in Table 4, max-Eigen and trace statistics reject the null hypothesis of no cointegration at the 5% level. Specifically, both statistics confirm the existence of one cointegrating equation among the variables. This confirms the convergence property; hence two-stage least square is presented.

Table 4: *Johansen Co-integration Test Results*

Null Hypothesis	Eigenvalue	Trace statistic	Critical value at 5 percent	Max-Eigen statistic	Critical value at 5 percent
$\alpha = 0$	0.692573	88.93141*	69.81889	57.79644*	33.87687
$\alpha \leq 1$	0.261595	31.13497	47.85613	14.85987	27.58434
$\alpha \leq 2$	0.177747	16.27511	29.79707	9.589676	21.13162
$\alpha \leq 3$	0.091876	6.685430	15.49471	4.722336	14.26460
$\alpha \leq 4$	0.039271	1.963094	3.841466	1.963094	3.841466

Notes: *α Represents at most the number of cointegrating equations. * Denotes significance at the 5% level.*
Source: Authors' computations using E-view 9.0

Interpretation of Simultaneous Equations Models

Table 5contains the results of the estimated two-stage leastsquares. Following Iyoha (2004), two-stage least squares (2SLS) will give consistent and asymptotically efficient estimates, provided the variables included in the model are stationary.Results contained in Table 5show that the coefficient of determination is very good considering Equation 2 with five explanatory variables, the R^{-2} adjusted explained about 98.88% of country differentialsin the crude birth rate in Nigeria. The F-value is highly significant; the hypothesis of a log-linear relationship between the six variables cannot be rejected at the one percent level of significance.

Table 5: *Estimated Two-Stage Least Square Regression Result for Crude Birth Rate*

Variable	Coefficient	Standard Error	t-Statistic	Probability
LGDPPC	0.00455	0.00101	4.5073	0
LILR	-0.0075	0.00235	-3.2054	0.0025
LCBR(-1)	0.89538	0.18453	4.85216	0
LTLF	0.02789	0.00643	4.3382	0.0001
LRWR	0.00028	0.00093	0.30165	0.7643
R-squared	0.99894			
Adjusted R-squared	0.98882			
S.E. of regression	0.00232			
F-statistic	85.8907			
Prob(F-statistic)	0			

Source: Authors' computation using E-view 9.0

The coefficients are in line with the *a priori* expectation. As expected, the lagged crude birth rate variable is significant and the three remaining variables (total labour participation rate, income per capita and illiteracy rate) are significant at one percent level of significance. However, the coefficient of wage rate is not significant. There is a positive and significant relationship between per capita income and crude birth rate. A1 percent increase in per capita income leads to 0.005 percent in the crude birth rate. This result aligned with the work ofSingh, Mittal, Sharma, Smarandache (2017). While education has an inverse relationship between education and crude birth rate, a 1 percent increase in education will reduce the crude birth rate by about 0.07 percent.This makes it easier for countries to develop. A more-educated workforce also makes poverty eradication and economic growth easier to achieve. The result was in line with Esping-Andersen and Billari, (2015).

Table 6: *Estimated Two-Stage Least Squares Regression Result for Per Capita Income*

Variable	Coefficient	Standard Error	t-Statistic	Probability
LCBR	0.13779	0.11975	1.15061	0.0881
LILR	0.15938	0.1643	1.97	0.0372
LGDPPC(-1)	0.86705	0.08091	9.77419	0
LRWR	0.07357	0.04053	1.82183	0.0455
C	1.86654	0.78252	2.38527	0.7019
R-squared	0.91943			
Adjusted R-squared	0.91227			
S.E. of regression	0.23351			
F-statistic	82.7757			
Prob(F-statistic)	0			

Source: Authors' computation using E-view 9.0

With the four variables employed (Table 6), the adjusted coefficient of determination can explain about 91.2 percent of the country differentials in per capita income. The F- value is highly significant; the hypothesis of a log-linear relationship between the four variables cannot be rejected at the one percent level of significance. As expected, the lagged per capita income variable is highly significant at 1 percent. Whereas, illiteracy rate and wage rateare significant at 5 percent while the crude birth rate is significant at the 10 percent level of significance.

To make further analysis of the regression results we need to obtain steady-state or long-run coefficients. To get these, let the value of the endogenous variables be stationary (i.e set $CBR^*=CBR_{-1}$ and $GDPPC^*=GDPPC_{-1}$). Therefore solving, we obtain

BR = 0.043464GDPPC -0.07192IR + 0.266546TLF + 0.002686WR (3)

GDPPC=1.036412BR* +1.19877IR + 0.553385WR + 14.03948 (4)

Since the variables are in logarithms, the coefficients are elasticities. But these elasticities measure only direct effects. In (3) a 1 percent increase in the literacy rate will lower birth rates by 0.02 percent. The statement ignores indirect effects, when the literacy rate increases, this affects income (raises it) which in return affects birth rates (raises it). Hence the indirect effect of a rising literacy rate is to increase the birth rate. To find out the net effect of literacy on the birth rate we need to calculate 'elasticity-multipliers' coefficients that measure both the direct and the indirect impacts of the exogenous variables on the endogenous ones. Thethree exogenous variables that have the greatest net impact on the endogenous are the literate rate (a proxy for education), the real wage rate and the total labour participation rate.

Table 5: *Steady-State Elasticity-Multiplier Coefficients*

Variables	LILR	LTLF	LRWR
CBR*	-0.0198	0.26655	0.0052
GDPPC*	1.12423	0.27625	1.12692

Source: Authors' computation.

From table 5 the net effect of education on the birth rate is negative while its net effect on income per capita is positive. A one percent jump in the literacy rate will lower the birth rate by about 0.02 percent. The highest elasticity multiplier in the table is that of income per capita by 11.3 percent. The intercept – the multiplier is 0.610208. It means that a one percent increase in the income per capita function will raise birth rates by 0.6 percent. Education has a positive effect on income per capita and a negative on the crude birth

rate. While the real wage rate has a positive effect on the crude birth rate which is not desirable.The real wage rate has a positive influence on per capita income,

5. CONCLUSIONSAND RECOMMENDATIONS

This simultaneous equation model of birth rate in Nigeria is particularly designed to account for both the direct and indirect effects which the selected variables have upon fertility rates and income per head. The results shows show that the most important variables are education, the labour force participation rate qualify as policy variables. Since lowering, birth rates and rising income per capita are two main goals of government in Nigeria. Education is a critical policy tool.Implementing some policy that will encourage education for labourforce toreduce birth rates to match the reduced death rates. Surely, labour-force education is not the onlyfactor controlling the crude birth rate, but it has a significant enough effect that it cannot be ignored.

As for a rising labour-force participation rate, this seems to be a mixed blessing; it raises income per capita which is desirable but also raises undesirable birth rates. Therefore, education has emerged as the most important policy instrument if the aim is to lower birth rates and raises per capita income levels in Nigeria. On education, the government need to take it very seriously and enforce very rigorously the statutory provision on free and compulsory basic education to eradicate illiteracy.

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