Journal of Sustainable Development in Africa (Volume 20, No.2, 2018)
*ISSN: 1520-5509*
*Clarion University of Pennsylvania, Clarion, Pennsylvania*

# SOCIOECONOMIC FACTORS THAT DETERMINE FERTILITY PATHWAY IN RELATION TO SUSTAINABLE DEVELOPMENT IN NIGERIA

**BY**

**Ernest Simeon O. Odior**
**Department of Economics, Faculty of Social Sciences**
**University of Lagos, Akoka, Lagos, Nigeria**

And

**Raymond Osi Alenoghena**
**Dept. of Economics, University of Lagos, Akoka, Lagos**

## ABSTRACT

*This paper assess the effects of socioeconomic variables on total fertility rate (TFR) in Nigeria, in relation to sustainable development. Methodically, this study models fertility rate function and employed the use of Engle-Granger single-equation to test for the cointegration and using the Generalized Linear Model method to dilate the explanatory variables effects on TFR. The result reveals that life expectancy has a high significant and positive impact on TFR. The result also reveals that the education expenditure has inverse and significant impact on TFR in Nigeria, but there seems to be no such strong inverse relationship between the level of per capita income and infant mortality rate on TFR. The study recommended that, governments and different organizations policy should be focus on the above importance fertility determinant and socioeconomic intervention policies should revise and implement to achieve further reduction of fertility and to enable Nigeria to attain stainable development.*

**Keywords: Socio-Economic, Fertility, Pathway, Sustainable Development, Nigeria**

## INTRODUCTION

There is a growing recognition that the present fertility pathways in most sub-Saharan African countries, including Nigeria, as a result of some favourable socioeconomic factors, do not augur well for the achievement of sustainable development. It must be stated that the fertility pathways of sub-Saharan Africa make it more difficult to attain sustainable development and attempts to improve the standard of living of the majority of the people on a sustainable basis is frustrated as a result of high fertility rate. This has brought human numbers into collision with the resources to sustain them.

On this basic, there is need to achieve a sustainable balance between the growth of population by controlling the rate of fertility, the environment and a decent standard of living for all the people. To achieve sustainable development and a higher quality of life for all people, countries should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate policies, including population related policies that related to fertility, in order to meet the needs of current generations without compromising the ability of future generations to meet their own needs. In other words, socio-economic development must be sustain able in terms of fertility rate and capable of meeting not only present needs, but those of future generations as well. ICPD Programme of Action, Chapter II, Principle 6 (UN, 1994)

Sustainable development as a means to ensure human well-being, equitably shared by all people today and in the future, requires that the interrelationships between population, resources, the environment and socio-economic development should be fully recognized, appropriately managed and brought into harmonious, dynamic balance. The challenge of reducing poverty and promoting human wellbeing, while at the same time ensuring the sustainability of the natural environment, is inseparable from fertility patterns and trends.

Intensive research in the field of human fertility has assumed tremendous importance in recent years. Fertility is the driving force of population growth in the world today. In other words, Fertility is an important factor in determining the trend of the growth of a country's population (Kaur, 2000). In some countries fertility has followed mortality in its decline. Births and deaths are in another equilibrium, producing slowly or no growth, but this time at lower levels. These are the countries that are close to zero population growth.

Uncontrolled fertility has been reported to have adversely influenced the socio-economic, demographic and environmental development of countries such as Ethiopia and other less developed countries.  In today's world there is no place for coercive measures of fertility control or for setting demographic targets. Such policies are contrary to the respect for human rights, and experience has shown that such measures are likely to be counterproductive in the long run.

The issue of fertility determinants and sustainable development in Nigeria becomes very important in the light of on-going government effort to check population growth. Nigeria is Africa's most populous country with about 181,181,744 and 185,989,640 million people in 2015 and 2016 respectively (World Bank Indicator, 2016). The United Nations says the population could reach 400 million by 2050.  That's a growth rate of 2.8 percent annually that economists say is unsustainably high for such a densely populated country plagued by poor infrastructure, poverty and unemployment (Onoja and Ikpotokin 2012). Nigeria is characterized by youthful population, rapid population growth, uneven population distribution, high fertility and rural-urban migration. This statistic shows the fertility rate in Nigeria from 2005 to 2015. The fertility rate is the average number of children borne by one woman while being of child-bearing age. In 2015, the fertility rate in Nigeria amounted to 5.59 children per woman. Today, Nigeria is among the countries with the highest fertility rate on the world fertility rate ranking.

The continuing population growth in Nigeria due to high fertility and declining mortality has brought human numbers into collision with resources to sustain them. A sustainable future involves a series of interlocking issues that must be dealt with simultaneously. It will be difficult to reduce high fertility rate quickly unless a successful war is waged on abject poverty. Sustainable development is an alternative to the" development at any cost"

The Nigerian Government has expressed concern about the high fertility rate of Nigerians, saying it has increased their tendency to procreate. The government, therefore called for a review of the country's population policy of 2004, warning that the urge for procreation had increased the country's maternal mortality. The government has called for a review of the nation's population policy in order to foster Nigeria's development. This research study attempts an empirical analysis of the determinants of fertility rate in Nigeria. Nigeria is an important country in the developing countries to study in part because of fertility rate started to decline very slowly (Feyisetan and Akinrinola, 2012) and the country has lagged behind others in the region in terms of economic development.

In the light of the strategic nature of this study, it has become important to assess the relative role of social and economic factors in fertility. The main aim of this study is to analyse the role and effects of the social and economic determinants of fertility in Nigeria and distinguish which of these factors are more pronounced impact for the current pattern of fertility decline during the periods 1980 to 2016. The range of research questions of concern are as follows: To what extent does per capita income influence the Nigeria national fertility level? Does education and health expenditures (human development) have much impact on the overall fertility level in Nigeria? How is the relationship between Life expectancy and Mortality and the overall fertility level in Nigeria? Is there any long run correlation and relationship between the variables under consideration?

It is worthy to note that, a number of studies have been published both within and outside Nigeria that bears on fertility rate and attendant consequences. Most studies conducted in this area with specific reference to Nigeria have been concerned purely with the determinants or general rate of fertility in the country. This study focuses on the possibility of socio-economic factors being the main determinant of total fertility rate in Nigeria. The study is immensely significant in various ways to policy makers. To policy makers like government agencies such as the National population commission, the finding and results of this study will provide invaluable insights and a more reliable guide to monitoring the fertility rate in Nigeria.

This study is organised into eight sections. Sections one is the introduction, giving a general idea of the research. Section two covers the existing literature on the issue. Section three analyse the current fertility pathway in Nigeria. Section four shows the theoretical framework and model specification. Section five is the model analytical framework and estimation techniques, while is six the analysis of empirical results of the study. Section seven and eight give the implication of findings and conclusion and recommendations of the study, respectively.

## RELEVANT LITERATURE REVIEW

The determinants of fertility have engaged the interest of economists for some time. A vast literature examines the effect on fertility of economic and social factors, from both a macro-level and a micro-level perspective. Fertility is influenced by a large number of factors such as age at marriage, use of contraceptives and socioeconomic factors like income, education, religion, caste and occupation. The most prominent factors are income (e.g., GDP per capita), urbanization, and educational attainment. In Bongaarts' framework, these socioeconomic factors are termed indirect determinants because they influence fertility indirectly, through one or more of the proximate determinants. Income and education, being predominant among the socioeconomic factors, assume special significance (Bongaarts, 1978).

According to Ushie (2009, CIA, 2014), TFR is a more direct measure of the level of fertility than the crude birth rate, since it refers to births per woman. Fertility refers to ‘the ability to conceive and bear children, the ability to become pregnant through normal sexual activity’ (MedicineNet.com). While General Fertility Rate (GFR) refers to the number of live births per 1000 women aged 15 to 49 in one year. On a general note, broader social, cultural, and economic conditions also influence fertility levels.

High fertility is defined as a total fertility rate (TFR) of 5.0 or higher. The TFR represents the average lifetime births per woman implied by the age-specific fertility rates prevailing in one historical period. There are micro- and macro-level demographic concomitants of a high TFR. At the micro level, they include a relatively high incidence of births of order five and above, a relatively high fraction of women experiencing pregnancies of order five and above, and a greater likelihood of short inter-pregnancy intervals. At the macro level, the main demographic feature is relatively rapid population growth rate (and corresponding rapid growth in the size of successive birth cohorts). These micro- and macro-level demographic features have consequences that have been identified in a large body of research. The key conclusions from that research are summarized here Casterline (2010)

In the view of Feyisetan (2012), fertility behaviour is conditioned by both biological and social factors. And as in other traditional African societies, several factors have contributed to sustain relatively high levels of fertility in Nigeria. These factors include high level of infant and child mortality, early and universal marriage, early child bearing as well as child bearing within much of the reproductive life span, low use of contraception and high social values placed on child bearing.

Angeles’ (2010) regression analysis of fertility decline in the period 1960–2000, for example, GDP per capita has the expected negative coefficient but its estimated effect is far weaker than mortality and education. One possible explanation for this relatively weak estimated effect is that the true effect of income growth on fertility is heterogeneous, raising the demand for children in some subgroups and lowering it in others (as economic theory would predict). It is also possible that Angeles’ and other analyses have shortchanged the effect of income by not fully accounting for indirect effects (through other determinants such as mortality and education). But even allowing for some under-accounting for the full causal effect of income, the bulk of the empirical evidence suggests that income growth *per se* is not essential for fertility decline.
Feyisetan and Bankole, (2012), set out to ascertain declining fertility trend in Nigeria and identify the key determinants that facilitated such trend. They concluded that a sustained fertility transition had commenced in Nigeria. They found out that the trend was more emphatic in the South than in the northern part of the country. The survey revealed that there was clamor to reduce the desired family size. Other important factors that determine the fertility transition included: use of contraception, changes in nuptiality patterns, particularly in the proportion marrying before age 20, and increased education of women. Further declines in desired family size were coupled with increased use of contraception for limiting, rather

than as a substitute for traditional birth spacing methods, increases in age at marriage and education of women are expected to generate further declines in fertility.

Ushie et all (2011) in their study examined the socio-cultural and economic determinants of fertility differentials in rural and urban Cross River State, Nigeria with specific focus on Calabar and Bendi communities. Survey design utilized data from a sample of eight hundred and eighty respondents which was drawn using purposive, quota and systematic sampling techniques. The study elicited data via structure questionnaire and focus group discussions (FGD). Hypotheses of the study were tested using bi-variate and multi-variate techniques. Findings revealed that age at entry into marital union, contraceptive use and educational level significantly determined fertility differentials between rural and urban communities in Cross River State. The study recommended among others that public enlightenment campaigns on the use of contraceptives and proper family planning should be embarked upon by relevant agencies.

Onoja and Ikpotokin, (2012) tested effects of some determinants of fertility on child bearing women to determine the level of fertility in Nigeria using data from the 2008 Nigerian Demographic Health Survey (NDHS). Data on 20,974 women were extracted from the 2008 NDHS data and analyzed using descriptive statistics and Poisson regression. Women with no education and those with secondary school education had 1.36 times risk and 17% increases in fertility (respectively) over those with higher education. Rural women were 1.02 times more likely to be at risk of high fertility compared to women in urban areas. Fertility level in Nigeria is higher in the rural areas than in the urban areas while level of education of women negatively impacted on their risk of having high fertility.

According to Olokor (2012) Nigeria have a total fertility rate (5.7) that is high and higher than many other countries of about similar level of development of 5.7 with huge regional differences (see the National Population Commission (NPC)): North-West and North-East having high total fertility rates." Adolescent childbearing has many negative health, social, and demographic consequences. Women who start having children at a young age often do not complete secondary school, limiting their future employment possibilities and other life choices. Additionally, early childbearing often results in larger families and reduced economic circumstances. Nationwide, 23% of girls age 15-19 have either already had a live birth or are pregnant with their first child. Women in this age group with secondary or higher education are least likely to have begun childbearing

## CURRENT FERTILITY PATHWAY IN NIGERIA

Fertility is one of the principal components of population dynamics that determine the size, structure, and composition of the population in any country, but high rate of fertility may have negative impact on sustainable development in the short and long run at the national and sub-national levels, but also at regional and global levels.

Measures of current fertility in Nigeria, presented in this section include age-specific fertility rates (ASFRs), the total fertility rate (TFR), the general fertility rate (GFR), and the crude birth rate (CBR). The rates are generally presented for the period 1-36 months preceding the survey, determined from the date of the interview and a child's birth date. A three-year period is chosen for calculating these rates to provide the most current information, to reduce sampling error, and to avoid problems associated with displacement of births.

NDHS (2013), survey fertility rates for the three years preceding for Nigeria as a whole and by urban-rural residence. Age-specific and total fertility rates, the general fertility rate, and the crude birth rate for the three years preceding the survey, by residence, Nigeria 2013. NDHS (2013) shows the estimates of ASFRs from the 2003, 2008, and 2013 surveys. In NDHS reports overall, fertility remained constant at 5.7 births per woman between 2003 and 2008 and is estimated at 5.5 births in 2013 (NPC, 2014).

The 2013 NDHS results indicate that the Total fertility rate (TFR), expressed per woman is 5.5 births per woman. This means that, on average, Nigerian women will give birth to 5.5 children by the end of their childbearing years. The current TFR of 5.5 is 0.2 children per woman less than that reported in the 2003 and 2008 NDHS surveys (5.7 each). Fertility peaks in the 25-29 age group in urban areas (237 births per 1,000 women) and the 20-24 age group in rural areas (267 births per 1,000 women) and declines thereafter.

The general fertility rate (GFR) is expressed per 1,000 women age 15-44, and it is 190, which means that there were 190 births for every 1,000 women during the three-year period preceding the survey. While Crude birth rate (CBR), expressed per 1,000 population. The crude birth rate was 39 per 1,000 population for the same period.

The 2013 NDHS also reported that Rural areas have a much higher TFR than urban areas (6.2 versus 4.7), and there are large urban- rural differences in ASFRs for all age groups. The largest variations are in the 15-19 and 20-24 age groups; in these groups, the rates for rural women exceed those for urban women by 100 and 79 births per 1,000 women, respectively. Adolescent fertility in rural areas more than doubles that in urban areas (see NPC, 2014)

NDHS (2013) results, show the variations in TFR by residence, zone, states, education, and wealth quintile. The more urbanised zones, the South East (4.7), South South (4.3), and South West (4.6), have lower fertility rates than the three mostly rural northern zones. The highest TFR is seen in the North West (6.7), followed by the North East (6.3). The TFR decreases with increasing level of education. Women with more than a secondary education have a TFR of 3.1, as compared with a TFR of 6.9 among women with no education. Women in the highest wealth quintile have an average of three fewer children than women in the lowest quintile (3.9 and 7.0 births per woman, respectively (NPC, 2014)

it is known that the level of fertility of any population is influenced by both indirect (socio-economic and cultural systems) and direct (proximate or intermediate) determinants factors, fertility rate in Nigeria is known to be unequal across geopolitical zones due to differences in culture, religious inclinations and some other contextual and individual based characteristics In particular, the North East and North West have consistently shown higher fertility rates over other regions since 1990 with the North Central following closely while the South west trails (NPC, 2011)

## THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

### Theoretical Framework

**Economic Theories of Fertility:** The economic approach to fertility first proposed by Becker (1960) explain three key factors at the root of fertility decisions: the income of the house hold; the price of children (the relative cost of children versus other goods and services); and the preference for children versus competing form of consumption. The microeconomic theory of fertility also known as the demand theory of fertility, that Becker (1960) considering both Malthusian and Darwinian approach to population. According to Becker (1960) the demand for children considered to vary with income, child costs, knowledge, uncertainty, and testes. An increase in income and a decrease in price have typically led to an increase of the demand for children, although it is important to recognize the quantity and quality of children may also choose to maximize the number of descendants in the next generation (Becker, 1991).

**Easterlin-Crimmins model:** Easterlin (1985) and his colleagues developed the Supply-Demand theory to identify and measure the determinants of fertility. The main important factors in Easterlin's model are the supply of and demand for children and the cost of fertility regulation. Those factors are the base for the analysis of fertility. They have made a sophisticated effort to combine economic and sociological approach of fertility decline. The demand factors include the standard socioeconomic determinants of the fertility transition used in the modernization hypothesis. The supply factors are environmental and cultural factors that constraint natural fertility. The level of fertility is affected by direct and indirect determinants. The indirect factors mainly of the socioeconomic character whereas direct are referred to as proximate determinants. For example education has an influence on fertility through influencing directly age at marriage or use of contraception (Bongaarts, 1978). Bongaarts (1978) identifies eight proximate determinants: marriage, contraception, induced abortion, lactation, infecund ability, fecund ability, spontaneous intrauterine mortality and sterility, through which socioeconomic and cultural factors affect fertility. Therefore, an adaptation of this framework is used in this study in order to identify the socioeconomic factors affecting fertility in East Africa selected countries.

The basic assumption of the analytical framework by Easterlin is that socioeconomic (modernization) and other proximate determinates are viewed as an important factors affecting reproductive outcomes by operating through the following three mediating variables. Demand for children: - the number of children parents would want if fertility regulation were costless. The supply of children: - the number of surviving children couples would have if they did not deliberately limit fertility. The cost of fertility regulation: - includes the economic, physical, health and social costs required to learn exercise family planning (Esterlin, 1975). Esterlin's framework shows how modernization influences fertility through intervening variables of supply, demand and cost of controlling birth.

The link between socio-economic determinants and fertility in the Easterlin-Crimmins model described GDP, infant mortality, inflation, HIV/AIDS prevalence, urbanization, education and adolescent fertility being channel through demand factors, supply factors and regulation coasts then through to proximate determinant and finally to fertility **(**Desta, 2010)

The above statement shows the pathway through which socioeconomic factors are likely to operate to influence fertility. Socioeconomic factors affect fertility both directly and indirectly through intermediate (proximate) variables. From the above theories, it is indicate that socioeconomic factors (modernization) influence the fertility regulation. In line with these theories, socioeconomic development, particularly urbanization, expansion of education and improving health facilities are some of the important driving force for fertility decline.

**Model Specification**

With refer to the theoretical frameworks stated above**,** special attention is paid to socioeconomic factors that affect fertility and identify the most crucial important variables for the decline of fertility in Nigeria from 1980 to 2016. Per capita income, education, health, life expectancy, and infant mortality variables used in this study that affect fertility directly and indirectly through proximate determinants. It is generally hypothesized that socioeconomic development determine fertility rate.

Specifically, we adopt the Economic Theories of Fertility and the Easterlin-Crimmins models. The main variables of interest argued in these theories include; Total Fertility Rate, Per capita income, Education Expenditure, Health Expenditure, Life Expectancy and Mortality rate. All variables are defined at aggregate level (national level). Therefore, the empirical model adopted in this study is thus specified as

$$TFR_t = \alpha_0 + \alpha_1 LOGPCI_t + \alpha_2 EEP_t + \alpha_3 HEP_t + \alpha_4 LEP_t + \alpha_5 MRI_t + \mu_t \quad (1)$$

$TFR_t$ is the total fertility rate at time $t$, sometimes also called the fertility rate, period total fertility rate (PTFR) or total period fertility rate (TPFR) of a population is the average number of children that would be born to a woman over her lifetime if: She were to experience the exact current age-specific fertility rates (ASFRs) through her lifetime, and She were to survive from birth through the end of her reproductive life. $LOGPCI_t$ at time $t$ is the Per capita income, also known as income per person, is the mean income of the people in an economic unit such as a country or city. It is calculated by taking a measure of all sources of income in the aggregate (such as GDP or Gross national income) and dividing it by the total population. $EEP_t$ at time $t$ is the Education expenditure (cost): This entry provides the total expenditure on education as a percentage of GDP. $HEP_t$ at time $t$ is the Health expenditures (cost): This entry provides the total expenditure on health as a percentage of GDP. $LEP_t$ at time $t$, is the Life expectancy at birth is also a measure of overall quality of life in a country and summarizes the mortality at all ages. $MRI_t$ at time $t$ is the Mortality rate, infant (per 1,000 live births), is define as the number of infants dying before reaching one year of age, per 1,000 live births in a given year.

The a-priori assumptions for the above model based on (equation 1) are: $\alpha_0 < 0$, $\alpha_1 > 0$, $\alpha_2 < 0$, $\alpha_3 < 0$, $\alpha_4 > 0$, $\alpha_5 > 0$. $\alpha,_S > 0$ implies a positive relationship between the dependent variable. This implies that an increase in these independent variables will lead to an increase in total fertility. $\alpha,\ _S < 0$ means that there is a negative relationship between the dependent variable and the independent variables.

## ANALYTICAL AND ESTIMATION TECHNIQUE

### Analytical Technique

This study hypothesis were tested using the Generalized linear models (GLM) to establish an empirical relationship between fertility rate in Nigeria and its socio-economic determinants, Generalized linear models estimation technique are a remarkable synthesis and extension of familiar regression models such as the linear models. Generalized linear models have become so central to effective statistical data analysis, however, that it is worth the additional effort required to acquire a basic understanding of the subject. The GLM approach is attractive because it (1) provides a general theoretical framework for many commonly encountered statistical models; (2) simplifies the implementation of these different models in statistical software, since essentially the same algorithm can be used for estimation, inference and assessing model adequacy for all GLMs.

### The Structure of Generalized Linear Models

The canonical treatment of GLMs is Nelder and Wedderburn (1972), and this review closely follows their notation and approach. Begin by considering the familiar linear regression model, $Y_i = X_i^{'}\beta + \varepsilon_i$, where $i = 1,\ldots,\mathrm{N}$, $Y_i$ is a dependent variable, $X_i$ is a vector of $k$ explanatory variables or predictors, $\beta$ is a $k$-by-1 vector of unknown parameters and the $\varepsilon_i$ are zero-mean stochastic disturbances. Typically, the $\varepsilon_i$ are assumed to be independent across observations with constant variance $\sigma^2$, and distributed normal. That is, the normal linear regression model is characterized by the following features:

a) A *random component* or stochastic component: specifying the conditional distribution of the response variable, *Yi* (for the *i*th of *n* independently sampled observations), given the values of the explanatory variables in the model. The $Y_i$ are usually assumed to have independent normal distributions with $\mathrm{E}(Y_i) = \mu_i$, with constant variance $\sigma^2$,or $Y_i \sim^{iid} N(\mu_i, \sigma^2)$

b) A linear predictor or systematic component: the covariates $X_i$ combine linearly with the coefficients to form the linear predictor $\eta_i = X_i^{'}\beta$. That is a linear function of regressors

$$\eta_i = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_k X_{ik} \tag{2}$$

c) A smooth and invertible linearizing link function $g(.)$, which transforms the expectation of the response variable, $\mu_i \equiv E(Y_i)$ to the linear predictor. That is the link between the random and systematic components: the linear predictor $X_i^{'}\beta = \eta_i$ is a function of the mean parameter $\mu_i$ via a *link* function, $g(\mu_i)$. Note that for the normal linear model, *g* is an identity.

$$g(\mu_i) = \eta_i = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_k X_{ik} \tag{3}$$

The corresponding density functions for the Normal distribution from the exponential family is given by:

$$f(y_i, u_i, \sigma^2, w_i) = \left(\frac{2\pi\sigma^2}{w_i}\right)^{-\frac{1}{2}} \exp\left(\frac{-(y_i^2 - 2y_i u_i + u_i^2}{2\sigma^2 / w_i}\right) for -\infty < y_i < \infty \tag{4}$$

**Estimation Technique**

As such an appropriate estimation procedure will be adopted. With the formulated models in equation 1, we carried out the model estimations. The first step is the unit root test which involves the determination of the order of integration, using the ADF - Fisher Chi-square test statistic. The second aspect is to test for cointegration, using the Engle-Granger single-equation cointegration test. The third aspect is the impact relationship between the dependent and the independent variables which is run over the sample period 1980 - 2016, using the Generalized Linear Model (GLM) (IRLS - Fisher Scoring) method. IRLS, which stands for Iterated Reweighted Least Squares, is a commonly used algorithm for estimating GLM models. IRLS is equivalent to Fisher Scoring, a Newton-method variant that employs the

Fisher Information (negative of the expected Hessian matrix) as the update weighting matrix in place of the negative of the observed Hessian matrix used in standard Newton-Raphson. The fourth and final test is for Specification Errors which is carried out by Ramsey Regression Equation Specification Error Test (RESET).

**Sources of Data**

The data for this study consists of annual time series, they are generated in line with the period covered by the study which is 1980 - 2016, a period of 37. This choice of this scope is predicated by the research method adopted for this work and following the purposes and objectives of the study. Also, 1980 - 2016 is a choice because the demographic variables such as TFR, Life expectancy at birth, Mortality rate etc. witnessed a constant annual growth during these periods. The data used for this study such as fertility rate, life expectancy, and other variables are obtained from the publications of World Bank indicators, 2016), CBN Statistical Bulletin (CBN, 2016) National Population Commission (2013 and 2014) and National Bureau of Statistical (NBS, 2006, 2016) to establish our empirical investigation of our formulated model.

## ANALYSIS OF EMPIRICAL RESULTS

**Unit Root Test**

Table 1 shows Augmented Dickey-Fuller (ADF) - Fisher Chi-square statistic test of unit root conducted on all the variables to test for stationarity of the variables. From the A(ADF) - Fisher Chi-square test statistics, the results show that LOGPCI, EEP and HEP were integrated at level, that is I(0) and TFR and LEP were integrated at order one, that is I(1) or they were stationary at first difference, while D(MRI) is integrated at order two, that is I(2) or it is stationary at second difference Comparing the variables levels with their first difference (the ADF unit root test statistic) and various probabilities, the test statistics show that the variables are integrated at order of one and two. All the variables were statistically significant at 1% and 5% level of significance in differences.

**Table 1: Stationarity Test Result**

| Series: TFR, LOGPCI, EEP, HEP, LEP, MRI | | | | |
|---|---|---|---|---|
| Method: | ADF - Fisher Chi-square | | | |
| Series | t-Stat | Prob. | Order of integration | Maximum Lag |
| D(TFR) | -10.132 | 0.0000 | I(1) | 1 |
| LOGPCI | -12.497 | 0.0000 | I(0) | 1 |
| EEP* | -4.0051 | 0.0180 | I(0) | 1 |
| HEP | -5.0267 | 0.0014 | I(0) | 1 |
| D(LEP) | -9.6116 | 0.0000 | I(1) | 1 |
| D(MRI,2) | -6.9267 | 0.0000 | I(2) | 1 |
| | | | | |
| | 1% level | -4.339330 | | |
| | 5% level | -3.587527 | | |
| | 10% level | -3.229230 | | |

Source: Authors' Computation

Note: *significant at 5% and 10% critical values

**Single-Equation Cointegration Test**

In this study, we carry co-integration test for the variables in the models using Engle-Granger cointegration test for a single-equation test. The result of co-integration for the variables is shown in table 2 below. The result shows that there exists one co-integrating equation at 1%, and 5% level of significance. This result indicates that there is a long run relationship between the dependent and all the independent variables used in both models.

**Table 2: Engle-Granger Cointegration Test Results**

| Series: TFR LOGPCI EEP HEP LEP MRI | | | | | |
|---|---|---|---|---|---|
| Null hypothesis: Series are not cointegrated | | | | | |
| Cointegrating equation deterministics: C | | | | | |
| Dependent | tau-statistic | Prob.* | z-statistic | Prob.* | Long-run residual variance |
| TFR | -6.241631 | 0.0067 | -36.87857 | 0.0055 | 0.026736 |
| LOGPCI | -14.78069 | 0.0000 | -38.21107 | 0.0032 | 0.014506 |
| EEP | -4.390767 | 0.1923 | -25.60488 | 0.1615 | 3.804205 |
| HEP | -5.351341 | 0.0392 | -32.30128 | 0.0280 | 0.656897 |
| LEP | -2.740743 | 0.8472 | -16.25033 | 0.6582 | 0.140343 |
| MRI | -7.509060 | 0.0004 | -42.76570 | 0.0004 | 8.257116 |

Authors' Computation

The Engle-Granger tau-statistic (t-statistic) and normalized auto-correlation coefficient (which we term the z-statistic) both do not reject the null hypothesis of no cointegration at the 5% significance level. The probability values are derived from the MacKinnon response surface simulation results. Given the small sample size of the probabilities and critical values there is evidence of four cointegrating equations at the 5% level of significance using the tau-statistic (t-statistic) and also, evidence of four cointegrating equations at the 5% level of significance using the z-statistic This implies that the both did not rejected the null hypothesis of no cointegration among the variables at the 5% level of significance. On balance, using the tau-statistic (t-statistic) and the z-statistic, the evidence clearly suggests that only TFR, LOGPCI, HEP and MRI are cointegrated at 1%-5% level of significance. This implies that there exists a long-run relationship or cointegration between total fertility rate and some of the listed determinants in this study (see Table 2).

Long-run residual variance" is the estimate of the long-run variance of the residual based on the estimated parametric model. The estimator is obtained by taking the residual variance and dividing it by the square of 1 minus the sum of the lag difference coefficients. These residual variance and long-run variances are used to obtain the denominator of the z-statistic.

**Interpretation of Estimated Coefficients**

**Table 3: Coefficients impacts Estimate**

| Dependent Variable: TFR | | | | | |
|---|---|---|---|---|---|
| Method: Generalized Linear Model (Newton-Raphson / Marquardt steps) | | | | | |
| Variable | Coefficient | | Std. Error | z-Statistic | Prob. |
| C | $\alpha_0$ | -6.281034 | 2.655436 | -2.365349 | 0.0180 |
| LOGPCI | $\alpha_1$ | 0.004622 | 0.002444 | 1.891163 | 0.0586 |
| EEP | $\alpha_2$ | -0.026933 | 0.014311 | -1.882071 | 0.0598 |
| HEP | $\alpha_3$ | 0.037814 | 0.036914 | 1.024377 | 0.3057 |
| LEP | $\alpha_4$ | 0.195182 | 0.039006 | 5.003856 | 0.0000 |
| MRI | $\alpha_5$ | 0.043696 | 0.006192 | 7.057366 | 0.0000 |
| a-priori assumptions: $\alpha_0 < 0$, $\alpha_1 > 0$, $\alpha_2 < 0$, $\alpha_3 < 0$, $\alpha_4 > 0$, $\alpha_5 > 0$ | | | | | |
| Akaike info criterion | | -0.474781 | Schwarz criterion | | -0.208150 |
| Hannan-Quinn criter. | | -0.382740 | Deviance | | 0.889771 |
| Deviance statistic | | 0.030682 | Restr. deviance | | 6.469714 |
| LR statistic | | 181.8652 | Prob(LR statistic) | | 0.000000 |

| | | | | |
|---|---|---|---|---|
| Pearson SSR | | 0.889771 | Pearson statistic | 0.030682 |

Source: Authors' Computation

The result find support for some hypotheses and overall the empirical results displayed the partial conformation to the previous researches. To test our hypothesis we used both the probability (p-value) of observing the t-statistic given that the coefficient is equal to zero. For this study we are performing the test at 10% significance level. The low probabilities values strongly rejected the null hypotheses and indicate that these variables are significantly in explaining the dependent variable in the model, while high probabilities values strongly accept the null hypotheses and indicate that these variables are not significantly in explaining the dependent variable in the model.

In the estimated regression line above, the value of $\alpha_0$ (the constant term) is -6.28 which means that holding the value of all the explanatory variables used constant or with no contribution of these variables to total fertility rate (TFR), the value of TFR will decline by 6.28% in Nigeria annually.

Two important variables estimated in this model are education expenditure (EEP) and health expenditure (HEP). The estimated regression line in Table 4 shows EEP is negatively related to total fertility rate (TFR) in Nigeria during the period under review. The regression coefficient EEP (-0.027), which implies that 2.7% of the decrease in TFR within the period under study was attributed to the changes in the education expenditure. The result of the analysis also shows that health expenditure (HEP) has positively impacted on total fertility rate (TFR). Though, HEP is positively impacted but not significantly. HEP result does not support the hypothesis and not in line with both theories and the previous researches that an increase in health expenditure will decrease fertility in the developing countries. The regression coefficient of HEP in the estimated regression line is 0.0378 which implies that 3.8% of the increase in TFR within the period under study was attributed to the 100% changes in the level of HEP.

Other important variables estimated in this model are per capita income (PCI), life expectancy (LEP) and Infant Mortality Rate (MRI). These result does support the hypothesis and in line with both theories and the previous researches that an increase in per capita income, life expectancy and infant mortality rate will increase fertility rate in the developing countries.

The estimated regression line in Table 4 shows that PCI, LEP and MRI are positively related to total fertility rate (TFR) in Nigeria and that they are significantly. The regression coefficient of LOGPCI, LEP and MRI are 0.004622, 0.195182 and 0.043696, respectively, which implies that 0.46%, 19.52% and 4.34% of the increase in TFR within the period under study was attributed to the changes in the level of PCI, LEP and MRI. However, one of the most unexpected finding in this study concerns the relationship between life expectancy and total fertility rate. The result shows high percentage impacts, it implies that this variable is a major contributor to fertility in Nigeria.

High fertility rate in Nigeria could be lowered by successfully implementing the recently agreed-upon Sustainable Development Goals (SDGs). The SDGs include specific quantitative targets on mortality, reproductive health, and education for all girls by 2030, measures that will directly and indirectly affect future demographic trends. Population trends are not explicitly mentioned in the SDGs, but several of the SDGs are directly or indirectly related to future demographic trends. The SDG goals related to child mortality, maternal mortality, causes of death, and reproductive health can be translated more or less directly into future mortality and fertility pathways (Guy, et al., 2016)

Lower fertility levels is one component of achieving sustainable development. The main task of improving health, education, per capita income, life expectancy and reducing infant mortality rate in relation to fertility is very important. Sustainable development requires that these trends be corrected. Expansion of the health system has also been rapid and the achievements of the educational policy have been equally impressive and also highly visible.

In the long term, slowing population growth by preventing unwanted pregnancies can contribute to the health of the environment and efforts to raise living standards of the present as well as future generations. This calls for strong support for family planning programmes. Reproductive health and family planning services should become part of efforts to conserve natural resources and improve the quality of human life.

Thus, the challenge of the century is to solve the problem of meeting the increasing needs and expectations of a growing population while at the same time modifying the current production and consumption patterns to achieve a more sustainable development model and address the links between development and rapid population change that resulted from high fertility.

**Regression Specification Error Test (RESET)**

**Table 4: Ramsey Reset Test Result**

| | | | |
|---|---|---|---|
| Specification: TFR C LOGPCI EEP HEP LEP MRI | | | |
| Omitted Variables: Squares of fitted values | | | |
| | Value | df | Probability |
| t-statistic | 3.535335 | 28 | 0.0014 |
| F-statistic | 12.49860 | (1, 28) | 0.0014 |
| Likelihood ratio | 12.49860 | 1 | 0.0004 |
| F-test summary: | | | |
| | Sum of Sq. | df | Mean Squares |
| Test Deviance | 0.274599 | 1 | 0.274599 |
| Restricted Deviance | 0.889771 | 29 | 0.030682 |
| Unrestricted Deviance | 0.615172 | 28 | 0.021970 |
| Dispersion SSR | 0.615172 | 28 | 0.021970 |
| | | | |
| LR test summary: | | | |
| | Value | df | |
| Restricted Deviance | 0.889771 | 29 | |
| Unrestricted Deviance | 0.615172 | 28 | |
| Dispersion | 0.021970 | | |

Source: Authors' Computation

In this study, Ramsey's (1969) Regression Specification Error Test (RESET) is use as a General Test for Functional Form Misspecification for the linear regression model. RESET has proven to be useful in this regard that is detecting neglected nonlinearities in estimated models. More specifically, it tests whether non-linear combinations of the fitted values help explain the response variable. The intuition behind the test is that if non-linear combinations of the explanatory variables have any power in explaining the response variable, the model is mis-specified. The following types of specification errors are test with RESET: (1) Omitted variables; the explanatory (LOGPCI EEP HEP LEP MRI) do not include all relevant variables. (2) Incorrect functional form; some or all of the variables in model should be transformed to logs, powers, reciprocals, or in some other way. (3) Correlation between explanatory variables and the error term, which may be caused, among other things, by measurement error in explanatory variables, simultaneity.

The result in Table 4 shows that the Ramsey RESET test used the powers of the fitted values of total fertility rate (TFR) as we assumed that all explanatory variables are exogenous and the test are likelihood ratio based tests. The top portion of the output shows the test settings, and the test summaries. Looking at the F-statistic, likelihood and probability value, the results show evidence of linearity with no case of omitted variables, incorrect functional form and correlation between explanatory variables and the error term.

## IMPLICATION OF FINDINGS AND CONCLUSION

This study has investigated the ability of fertility theories to match the relationship between fertility and per capita income, education expenditure, health expenditure, life expectancy and infant mortality and the extent to which these socioeconomics factors contribute to fertility rate and how it impacted on sustainable development Nigeria.

Sustainable future involves a series of interlocking issues that must be dealt with simultaneously. This study shows that toward constructing a the sustainable development goals (SDG), this depends on population scenario such as, translating the health and education targets into fertility and mortality assumptions, child mortality targets, reproductive health targets and effect of education targets on mortality and fertility.

Population growth and development are linked in complex ways. Economic development generates resources that can be used to improve education and health. These improvements, along with associated social changes, reduce both fertility and mortality rates. On the other hand, high rates of population growth that eat into surpluses available for economic and social development can hinder improvements in education and health.

Education is a crucial determinant of individual empowerment and human capital, is a key driver of socio-economic development (public health, economic growth, quality of institutions and democracy, and adaptive capacity to climate change). Good health is the foundation of human welfare and productivity. Hence a broad-based health policy is essential for sustainable development. In the developing world, the critical problems of ill health are closely related to environmental conditions and development problems. In a world where many live without adequate healthcare it seems implausible that the SDG target of universal health coverage by 2030 is possible.

In comparing these research results with previous findings, some of these results contradicts the finding of many scholars or with the postulated theories. The possible explanation for this inconsistent relationship is that in developing countries is because of the endoginiety of some of the explanatory variables. It is also instructive to note that many countries of the world whose economies are strong do check high fertility

This study confirmed that the listed socio-economic determinants of fertility were strongly association with fertility level when studied with a multiple regression analysis. Total fertility rate was regressed on, income per capital, education cost, health cost, Life expectancy and infant mortality rate. The result reveals that life expectancy has a high significant and positive and significant impact on total fertility rate. This may be true when people's perception of longevity can be both positive and negative, depending on the circumstances and future prospects. Also, the result shows that health expenditure has insignificant and positive effect on total fertility rate. That is, the impact resulting from the increase in the health costs is not significant. The implication of this is that the higher the health position of the economic units the higher the fertility rate.

The result also reveals that the education expenditure has inverse (negative) and significant impact on total fertility rate in Nigeria, but there seems to be a positive relationship between the level of per capita income and infant mortality rate and fertility rate. As such, all these variables helps in controlling the growth of population. Infant mortality positive impacts implies that, fertility is also higher where infant mortality are high. For the inverse relationship between education expenditure and fertility, in implies that, the number of children depends on the education cost.

Hence, the results found in this study support the interpretation that socioeconomic has created the opportunities which were important for the fertility decline and increase. However, the magnitude of socioeconomic factors effect on fertility levels seems not strong as expected apart from life expectancy, therefore, there is a need to manipulate the socioeconomic factors operate through proximate determinants in order to have further impact of socioeconomic factors on fertility.

In Nigeria, the more children a woman (or a couple) is able to procreate, the matrimonially fulfilled the culture considers her, it is said that less developed countries like Nigeria could only grow economically if population growth is held in check. For instance, uncontrolled fertility has been reported to have adversely influenced the socio-economic, demographic and environmental development of countries such as Ethiopia and other less developed countries. Clearly, we concluded that social economic factors have great influence on the level of fertility in Nigeria and that household's decision on the ideal/preferred number of children is influenced by a wide range of important socio-economic factors such as education, income levels etc.

**POLICY RECOMMENDATIONS**

The relationship between socioeconomic and fertility has recently received considerable attention, with some studies claiming that the established negative correlation between fertility and measures of socioeconomic. Review of the major determinants of fertility (previous section), provides a framework for considering policy options. Therefore, the following recommendations have been outlined which may be useful in assisting the total fertility rate in Nigerians:

i. Turning now to the population-sustainable development link, there is the urgent need to adopt relevant population policies as a basic strategy in sustainable development. These national policies should respond to individual and community needs with special reference to eliminating poverty and improving health, education, per capita income, life expectancy and reducing infant mortality rate.
ii. For declines in fertility to be sustained, there must be changes in fertility norms towards smaller family size. Fertility norms, usually reflected by the demand for children, are most often measured by the number of children desired under prevailing social and economic conditions. Although it is sometimes influenced by the number of living children, patterns of changes and differentials in desired fertility sometimes provide valuable insight into probable future course of fertility.
iii. Consistent with the theory of the demographic transition, a future decline in fertility could be anticipated when fertility desires decline and become much lower than actual fertility. Changes in desired fertility reflect changes that would have occurred in achieved fertility had desires translated into behaviour. To make predictions about future course of fertility in Nigeria, there is the need to investigate patterns of change in fertility norms.

iv. Finally, governments and different organizations policy should be focus on the above important determinants of fertility and socioeconomic intervention policies should revise and implement to achieve further reduction of fertility in Nigeria.

## REFERENCES


Angeles, L. (2010). Demographic Transitions: Analysing the Effects of Mortality on Fertility." *Journal of Population Economics* 23: 99–120.

Becker, G. S. (1960). An Economic Analysis of Fertility *in Demographic and Economic Change in Developed Countries.* Princeton, NJ: Princeton University Press and NBER.

Becker, Gary. (1991). A Treatise on the Family. Enlarged edition. Cambridge, MA: Harvard University Press.

Bongaarts J. (1978). A Framework For Analysing The Proximate Determinants Of Fertility", *Population and Development Review,* 105-132 (1978).

CIA, World Fact Book (2014). https://www.cia.gov/library/publications/the-world-

Campbell, O. and Graham, W. (2006). Strategies for Reducing Maternal Mortality: Getting on With What Works. *Lancet* 368: 1284–1299

Casterline, J. B. (2010). Determinants and Consequences of High Fertility: A Synopsis of the Evidence

Desta M. (2010). Fertility in East Africa countries, The role of socioeconomic factors in East Africa 1998-2010, Unpublished Master's Thesis, Department of Economic History, School of Economics and Management, Lung University.

Easterlin, A. R. (1975). An Economic Framework for Fertility Analysis. Studies in Family Planning 6(3): 54-63.

Easterlin, A.R. and M.E. Crimmins (1985). The Fertility Revolution: A Supply-Demand Analysis. Chicago: University of Chicago Press

Feyisetan, Bamikale J. and A. Bankole (2012). Fertility Transition in Nigeria: Trends and Prospect Revised Bankole paper.

Guy J. Abel, Bilal Barakat, K.C. Samir and Wolfgang Lutz (2016). Meeting the Sustainable Development Goals leads to lower world population growth, Sustainability Science

Kaur, H. (2000), Impact of Income and Education on Fertility, The Journal of Family welfare

National Population Commission (Nigeria) (2011), Nigeria Demographic and Health Survey (NDHS)

National Population Commission (Nigeria) (2014), Nigeria Data for National Development

National Population Commission (Nigeria) (2014), Nigeria Demographic and Health Survey (NDHS), 2013.

Olokor, F. (2012), Federal Government of Nigeria Worries Over High Fertility Rate, Seeks *Review of Population Policy*

Onoja, M. A. and O. Ikpotokin (2012). Modeling the Determinants of Fertility among Women of Childbearing Age in Nigeria: Analysis Using Generalized Linear Modeling Approach, *International Journal of Humanities and Social Science Vol. 2 No. 18.*

Shapiro, D. and T. Gebreselassie (2008). Fertility Transition in Sub-Saharan Africa: Falling and Stalling. *African Population Studies* 23(1): 3–23.

UN (1994). Report of the International Conference on Population and Development (ICPD), Cairo, 5-13 September 1994, A/CONF.171/13, 18 October 1994, New York, NY.

Ushie M. A. (2011). Socio-cultural and economic determinants of fertility differentials in rural and urban Cross Rivers State, Nigeria, *Journal of Geography and Regional Planning*, Vol. 4(7), pp. 383-391

Ushie, M. A (2009). Fertility Differentially in Urban and Rural Nigeria: A Comparative Study of Calabar and Bendi Communities in Cross River State, Nigeria. Unpublished Doctoral Thesis, University of Calabar, Calabar – Nigeria.

World Bank Development Indicator (2016). http://data.worldbank.org/indicator/Sp.Pop.Totl


## ABOUT THE AUTHORS:


Dr. Ernest Simeon Osikhena Odior is a Professional Economist, an African scholar. Currently, Odior is a Senior Lecturer and consultant in the Department of Economics, University of Lagos, Nigeria.

Raymond Osi Alenoghena works in the Department. of Economics, University of Lagos, Akoka, Lagos