Demographic Transition in the Past and Projected Five Decades in Sub-Saharan Africa, 1967-2068: Empirical Evidence from Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author HIE designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Authors CAO and ESE managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study assessed the demographic transition in the past and projected five decades in Sub-Saharan Africa, 1967-2068: Empirical evidence from Nigeria.
Study Design: Past and projected time series data (between 1967 and 2068) were used for the study. The 1967-2068 data sets were resorted to due to lack of complete national data.
Place and Duration of Study: Past (between 1967 and 2017) and projected (between 2018 and 2068) five decades in Nigeria.
Methodology: The time series data (1967 to 2068) obtained from the 1950-2099 Interpolated Demographic Data of the United Nations Population Division, Department of Economic and Social Affairs, on Births, Deaths and Population levels, were used for the study. The 1967-2068 data sets were resorted to due to lack of complete national data. Data collected were analyzed using birth

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and death rate indices, demographic transition index, growth rate equation and granger causality statistics. Unit root, co-integration and error correction tests were also carried out.

Results: Results showed that in the past five decades (1967-2017), the mean crude birth and death rates per 1,000 populations were 43.9 and 18.0 respectively; while that of the projected five decades (2018-2068) was 28.9 and 7.9 respectively per 1000 populations. The demographic indices showed that in the past five decades (between 1967 and 2017), Nigeria was at the second stage (stage II) of demographic transition and expected to remain at this stage in the next five decades (between 2018 and 2068). Results also showed that the population growth rate in the past five decades was 2.584 percent, while the growth rate in the next five decades as projected was 2.098 percent. The population growth rate (2.098 percent) in the next five decades (between 2018 and 2068 as projected) is expected to decrease by an average of 0.486 percent. Results also showed that there is a mutual link between demographic transition and population growth.

Conclusion: Nigeria is currently at the second stage of demographic transition and expected to remain at this stage (stage II) in the next five decades. Demographic transition increases the prediction of population growth and vice versa.

1. INTRODUCTION

An important transition in the economic history of countries occurs when they move from a regime of low prosperity, high child mortality and high fertility to a state of high prosperity, low child mortality and low fertility [1]. Demographic transition is a population theory that relates economic development to patterns of population growth, describing the transition from high birth and death rates to low birth and death rates [2] The transition is also an indication of a shift away from a stable and stationary stage of population [3], which begins with a decline in mortality while fertility remains persistently high, and leads to a regime of high population growth [4]. An increase in population growth at the start of the demographic transition results from a decline in mortality rates as population health improves, and a later decline in population growth arises from a decline in fertility rates [5].

Demographic transition is not only consisting of population growth tendency but much more along with economic consequences [6]. Demographic transition is a four-stage historical process of population growth; first, high birth rates and high death rates; second, high birth rates and low death rates; and third, low birth rates and low death rates; a fourth stage in which deaths out-number births has made its appearance in the most industrialized nations. In the first stage of demographic transition (in pre-industrial society), death rates, and birth rates are high and roughly in balance (fluctuated rapidly according to natural events, such as famine, drought, and disease). During this agricultural revolution, birth and death rates both tend to be very high in this stage and because both rates are approximately in balance, population growth is typically very slow in stage one. In the second stage, death rates drop rapidly owing to improvements in food supply and sanitation, which increase lifespan and reduce disease. The improvements specific to food supply typically include selective breeding and crop rotation and farming techniques. Other improvements generally include access to technology, basic health care, and education. Countries in this stage experience a large increase in population, as death rate decline without a corresponding fall in birth rate [7].

In stage three, birth rates fall owing to access to contraception, increases in wages, urbanization, a reduction in subsistence agriculture, an increase in the status and education of women, a reduction in the value of children's work, an increase in parental investment in the education of children and other social changes [8], hence population growth begins to level off. The fourth stage (corresponding to contemporary societies) is characterized by low birth rates and low death rates as observed in advanced economies [9]. Birth rates drop to well below replacement level, as it is happening in countries like Germany, Italy, and Japan, leading to a shrinking population, a threat to many industries that rely on population growth. Death rates may remain consistently low or increase slightly as a result of increases in lifestyle diseases arising from low exercise levels, high obesity and an aging population in developed countries.

Some theorists argue that a fifth stage is needed to represent countries that have sub-replacement

fertility (that is, below 2.1 children per woman). Most European and many East Asian countries now have higher death rates than birth rates. In this stage, population aging and population decline will eventually occur to some extent if mass migration does not occur. However, some theorists submitted that there may be a further stage of demographic development. According to Myrskyla et al. [8], advances in developments reverse fertility declines, indicating that previously negative relationship between national wealth (as measured by the Human Development Index (HDI)) and birth rates have become J-shaped. Development promotes fertility decline at low and medium HDI levels, but advanced HDI promotes a rebound in fertility. In many countries with very high levels of development fertility rates are now approaching two children per woman, although there are exceptions, notably in Germany and Japan [8].

Each stage of demographic transition and the resulting increase in population growth is marked with opportunities and challenges. Whether population dynamics pose challenges or bring opportunities depends largely on the policies that are in force [10]. Sub-Saharan Africa (SSA) has experienced, and is projected to experience, rapid population growth from 183 million in 1950 to 863 million in 2010 and 1,753 million in 2050 [11]. Population increase in some Sub-Saharan African countries, as demographic transition occurs, has limited social and economic development as many of the virtuous mechanisms linking demographic transition to social change and development are slowed down. Binswanger-Mkhize and Savastano [12] reported that increase in population has led to unsustainable production practices due to the need to satisfy the growing demand for food and other land resources. At extreme cases, the transition and corresponding rise in population produces social stresses such as hunger due to low productivity and loss of arable lands. Population dynamics do not only pose challenges, they also provide important opportunities for more sustainable development. A fall in fertility levels and slower population growth, for example, leads to an increased concentration of the population in the working age range, which can enable countries to reap a demographic bonus and jumpstart economic development [10].

1.1 Concept of Demographic Transition

The term demographic transition was first used by F. W. Notestein in 1945 to describe the changes in birth and death rates that historically have accompanied the shift from a traditional to a modern society. With modernization (a complex term indicating social and economic development), sharp declines in mortality have been followed by a reduction in fertility, although unduly lagging by years or decades [3]. The term transition refers to the shift away from a stable, high – stationary stage of population in which very high birth rates are balanced by very high death rates and there is little or no population growth. Demographic transition is a population theory that relates economic development to patterns of population growth. Demographic transition is the process whereby a country moves from high birth and high death rates to low birth and low death rates with an increase in population growth. Demographic transition is a four-stage historical process of population growth; first, high birth rates and high death rates; second, high birth rates and low death rates; and third, low birth rates and low death rates; a fourth stage in which deaths out-number births has made its appearance in the most industrialized nations [7]. Consequently, as illustrated by Ogunbameru [13], the four demographic stages are:

1. Births high + Deaths high = Stable population at low level.
2. Births high + Deaths low = A growing population with spreading age base.
3. Births low + Deaths high = A declining population.
4. Births low + Deaths low = Stable population but aging.

Any such shift in population structure is called a demographic transition and can be of several kinds. In this case, the birth rate is the number of babies born every year for every thousand of a given population. The birth rate is called crude birth rate, which indicates that it is not a refined measure of fertility. One major purpose of this measure is that it described the impact of fertility on population growth. The death rate is the number of deaths in a year for every 1000 members of a population. It is the simplest and commonest measure of mortality. Like birth rate, death rates are affected by many population characteristics, particularly age and age structure. Death rate has specific and general meaning. In specific terms, it could refer to the general death rate from the total population of an area. More generally, it may be used to refer to the general death rate for any population (the male and female population).

The main contribution of demographic thinking to wider debates about population change is the demographic transition theory. This has had a deep impact on the work of national and international agencies in both the developed and the developing world for the last 50 years. The theory identifies different stages of demographic transition based on fertility and mortality levels, ranging from stage one, when fertility and mortality are balanced at very high levels; to stage two, when mortality starts to decrease and fertility subsequently declines; to the third stage, when population growth is close to zero, with low birth and death rates. This pattern has been experienced by every country in the developed world and has been crucial for studies of the relationship between fertility and mortality. The population size starts to rise soon after due to the larger number of surviving children. The surviving children grow to an age in which they procreate, and the birth rate increases, which increase the population size even further. The size of families with surviving children gets very large and fertility drops. Finally, the population has momentum and overshoots the new equilibrium and then relaxes to the new equilibrium. This causes the population to age temporarily before increasing fertility drives the population to the new equilibrium. This plot has the characteristic signature of the demographic transition [14].

In stage one, in pre-industrial society, death rates, and birth rates are high and roughly in balance (fluctuated rapidly according to natural events, such as famine, drought, and disease). All human populations are believed to have had this balance until the late 18th century, when this balance ended in Western Europe. During this agricultural revolution, birth and death rates both tend to be very high in this stage and because both rates are approximately in balance, population growth is typically very slow in stage one [7,15]. Children contributed to the economy of the household from an early age by carrying water, firewood, and messages, caring for younger siblings, sweeping, washing dishes, preparing food, and working in the fields. Raising a child cost little more than feeding him or her; there were no education or entertainment expenses. Thus, the total cost of raising children barely exceeded their contribution to the household. In addition, as they became adults they become a major input to the family business, mainly farming, and were the primary form of insurance for adults in old age. While death rates remained high there was no question

as to the need for children, even if the means to prevent them had existed [16,15].

In stage two, the death rates drop rapidly owing to improvements in food supply and sanitation, which increase lifespan and reduce disease. The improvements specific to food supply typically include selective breeding and crop rotation and farming techniques. Other improvements generally include access to technology, basic health care, and education. For example, numerous improvements in public health reduce mortality, especially childhood mortality. Prior to the mid-20th century, these improvements in public health were primarily in the areas of food handling, water supply, sewage, and personal hygiene. Interestingly, one of the variables often cited is the increase in female literacy combined with public health education programs which emerged in the late 19th and early 20th centuries. The death rate decline without a corresponding fall in birth rates which produces an imbalance and the countries in this stage experience a large increase in population.

In stage three, birth rates fall owing to access to contraception, increases in wages, urbanization, a reduction in subsistence agriculture, an increase in the status and education of women, a reduction in the value of children's work, an increase in parental investment in the education of children and other social changes. Population growth begins to level off [15]. The birth rate decline in developed countries started when contraception improvement played a role in birth rate decline. Notwithstanding, contraceptives were not generally available nor widely used in the 19th century and, then, it did not play a significant role in the decline. Birth rate decline was caused by a transition in values and not just because of the availability of contraceptives. As a population continues to move through the demographic transition into the third stage, fertility declines and the youth bulge prior to the decline ages out of child dependency into the working ages. This stage of the transition is often referred to as the golden age, and is typically when populations see the greatest advancements in living standards and economic development [17,15].

In stage four, there are both low birth rates and low death rates. Birth rates drop to well below replacement level, as it is happening in countries like Germany, Italy, and Japan, leading to a shrinking population, a threat to many industries that rely on population growth. As the large group

born during stage two ages, it creates an economic burden on the shrinking working population. Death rates may remain consistently low or increase slightly as a result of increases in lifestyle diseases arising from low exercise levels, high obesity and an aging population in developed countries. However, by the late 20th century, birth rates and death rates in developed countries leveled off at lower rates. Some theorists argue that a fifth stage is needed to represent countries that have sub-replacement fertility (that is, below 2.1 children per woman). Most European and many East Asian countries now have higher death rates than birth rates. In this stage, population aging and population decline will eventually occur to some extent if mass migration does not occur. However, some theorists submitted that there may be a further stage of demographic development. According to Myrskyla et al., 2009), advances in developments reverse fertility declines, showing that previously negative relationship between national wealth (as measured by the Human Development Index (HDI)) and birth rates have become J-shaped. Development promotes fertility decline at low and medium HDI levels, but advanced HDI promotes a rebound in fertility. In many countries with very high levels of development (around 0.95) fertility rates are now approaching two children per woman, although there are exceptions, notably in Germany and Japan [8].

Using past birth and death rate statistics over a long period of time, a model called the demographic transition model, was developed. It suggests that all countries pass through similar population stages, as shown in Fig. 1. After fluctuating high birth and death rates in stage 1, death rates fall because of better medical care and improved food production. With birth rates fairly constant, the fall in the death rate results in a rapid population increase in stage 2 of the model. In stage 3, birth rates also fall because of family planning and the desire for more material possessions instead of children. In stage 4, birth and death rates level out. According to this model, this sequence of change should apply to low economically developed countries as they become industrialized and standards of living should rise just as they did in the past for many developed countries [18].

1.2 Objectives of the Study

The broad objective of the study was to assess the demographic transition in the past and

projected five decades in Sub-Saharan Africa, 1967-2068: empirical evidence from Nigeria. The specific objectives were to;

i. Determine the stage of demographic transition in the past five decades in Nigeria,
ii. Ascertain the stage of demographic transition in the next projected five decades in the country,
iii. Assess the level of population growth in the country,
iv. Determine the relationship between demographic transition and population growth rate in the country, and make policy recommendations.

1.3 Hypotheses of the Study

The null hypotheses tested were that;

i. Demographic transition does not cause population growth in the country;
ii. Population growth does not cause demographic transition in the country.

1.4 Limitations of This Paper

This paper is restricted to ascertaining the stages of demographic transition in the past and projected five decades in Nigeria from 1967-2068.One of the limitations arises from the variables included in the Demographic Transition Model (DTM). There are number of demographic variables that influence population growth which should also be included in the Demographic Transition Model (DTM). Variables such as immigration, emigration, etc., are not included. Authorities in Demographic Transition consider Births and Deaths in developing the Demographic Transition Model (DTM) and in describing each demographic stage, hence the use of Births and Deaths in this paper.

The data used for this paper considers 1967-2017 as past period and 2018-2068 as the projected period. The relevance of data for any period before or after these periods is not considered.

2. METHODOLOGY

2.1 Study Area

Nigeria where this study was carried out is located in West Africa on the Gulf of Guinea and has a total area of 923,768 km[2] [19]. The country
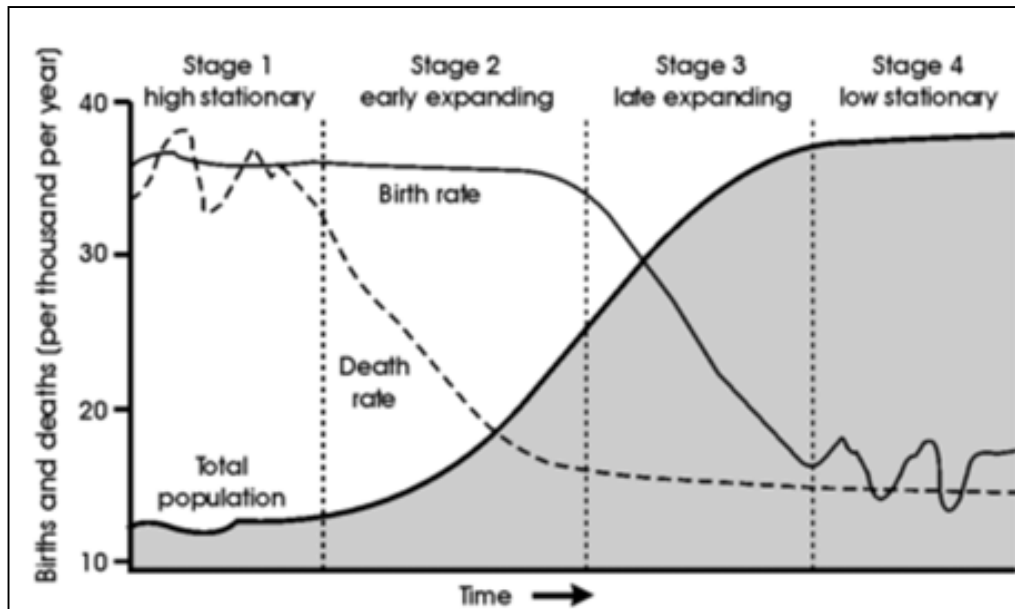
Fig. 1. The demographic transition model
Source: Longman Reference Guide; Henslin [7]

is bordered in the south by approximately 800 km of the Atlantic Ocean, on the West by the Republic of Benin, on the North by the Republic of Niger and Republic of Cameroun on the East [20], as shown in Fig. 2. Nigeria lies between Latitudes 4 and 14 N and Longitudes 2 and 15 E [21]. There are 36 states and the Federal Capital Territory Abuja. The states are aggregated into six geopolitical zones: North West, North East, North Central, South East, South South and South West [22]. The country's population is about 201.3 million persons [23]. Of the urban population, 27 per cent is food insecure, compared to 44 per cent of the rural population. Socio-cultural barriers still impede many healthy household practices; the rate of exclusive breastfeeding is just 15 per cent, and only 49 per cent of babies are delivered by skilled attendants [24].

Under-five mortality fell from 201 deaths per 1,000 live births in 2003 to 124 per 1,000 in 2011, while infant mortality fell from 100 to 78 per 1,000 between the same referenced years. The maternal mortality ratio has improved, dropping from 800 per 100,000 live births in 2000 to 630 per 100,000 live births in 2011 [25]. The main causes of infant and child deaths are pneumonia, diarrhoea, malaria and neonatal causes, compounded by under-nutrition and vaccine-preventable diseases. The poorest population quintile has an under-five mortality rate of 220

per 1,000 births, compared to 90 per 1,000 among the richest quintile [25]. Total fertility rates in Nigeria have assumed a downward trend from an average of 6 children per woman in 1990 to 5.5 in 2013 [26]. Within the population, the age structure comprised 0-14 years, 15-24 years, 25-54 years, 55-64 years, and 65 years and over. The proportion of the population of the age structure estimates for the 2012 for the age cohort of 0-14 years was 43.9%; 19.3% for the age cohort of 15-24 years; 30% for the age cohort of 25- 54 years; 3.8% for the age cohort of 55-64 years; and 3% for the age cohort of 65 years and over [27]. The projections for birth rate in Nigeria showed 39.23 births/1,000 persons and the death rates showed 13.48 deaths/1,000 persons [28].

2.2 Data

The time series data (1967 to 2068) obtained from the 1950-2099 Interpolated Demographic Data of the United Nations Population Division, Department of Economic and Social Affairs, on Births, Deaths and Population levels, were used for the study. The 1967-2068 data sets were resorted to due to lack of complete national data. Data collected were analyzed using birth and death rate indices, demographic transition index, growth rate equation, and granger causality statistics. Unit root, co-integration and error correction tests were also carried out.
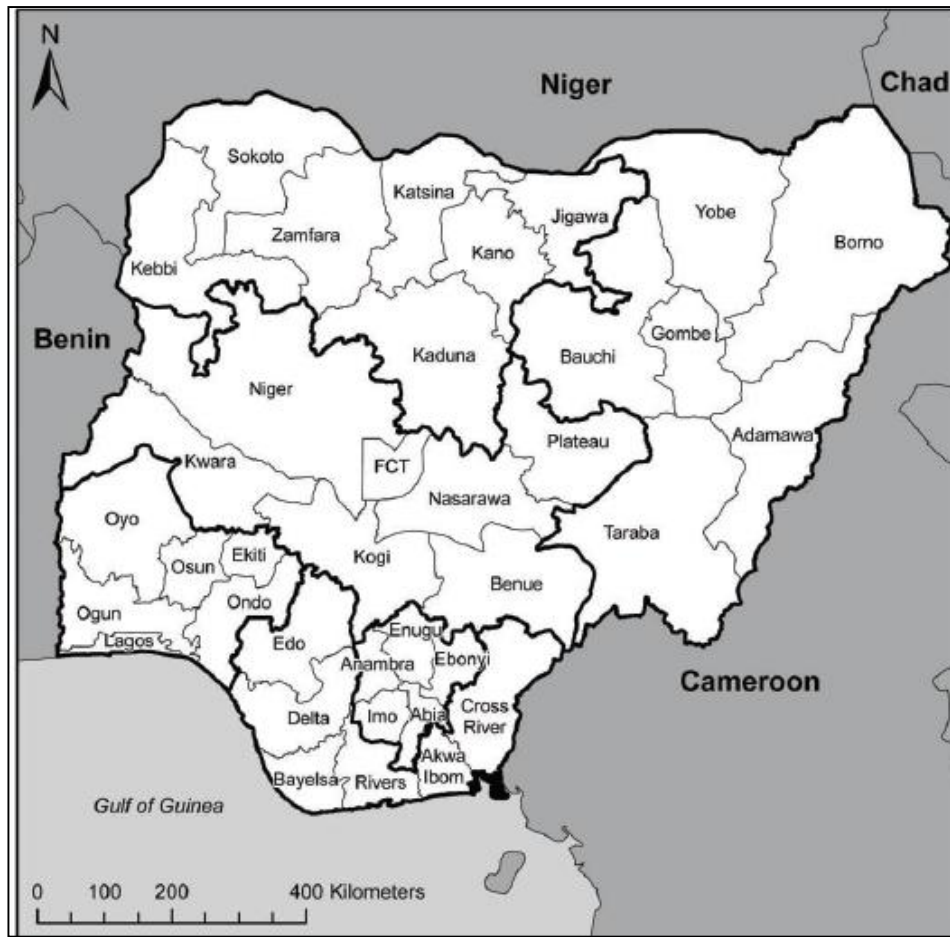
Fig. 2. Map of Nigeria
Source: National Population Commission and ICF Macro [29]

2.3 Analytical Techniques

2.3.1 Stage of demographic transition in the past and projected decades in Nigeria

The past and projected stage of demographic transition in the study area was analyzed using the Descriptive Statistics, Birth and Death Rate Indices. In this case, the birth and death rates resulting in a given level of population growth were used to describe the stage of demographic transition in the country. Following Henslin [7] and other demographers, there are four common demographic stages based on the following decision rule:

Stage 1: High Births + High Deaths = Stable population at low level.
Stage 2: High Births + Low Deaths = A growing population with spreading age base.

Stage 3: Low Births + High Deaths = A declining population.
Stage 4: Low Births + Low Deaths = Stable population but aging.

The models are stated as:

$$Br_t = \frac{Total\ live\ births}{Total\ population} \times 1000 \qquad (1)$$

While,

$$Dr_t = \frac{Total\ deaths}{Total\ population} \times 1000 \qquad (2)$$

Where,

Br_t = Birth rate for the time period, t (in number per 1000)

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Dr_t = Death rate for the time period, t (in number per 1000)

The past and projected stages of demographic transition were therefore determined as:

$$DT_t = \frac{Br_t}{Dr_t} \times 100 \qquad (3)$$

a) $DT = 100\%$ => Stage 1, if:

i. High Birth + High Death (for High values of birth and death)
    = > Stage 4, if:
ii. Low Birth + Low Death (for low values of births and death)

b) $DT > 100\%$ => Stage 2 (High Birth + Low Death)

c) $DT < 100\%$ => Stage 3 (Low Birth + High Death)

Where,

Br_t = Birth rate for the time period, t (in number per 1000)
Dr_t = Death rate for the time period, t (in number per 1000)
DT_t = Demographic transition for the time period, t (percent)

2.3.2 Level of population growth

Using the projected data obtained from the United Nations Population Division, Department of Economic and Social Affairs (for Nigeria) within the periods under consideration, the level of population growth was determined using the growth model stated as in Jebweb, Christiaensen and Gindelsky [30]:

$$K = \left[\left(\frac{g_{t+1}}{g_t} \right)^{\frac{1}{m}} - 1 \right] \times 100 \qquad (4)$$

Where,

K = Population growth rate (percent)
m = Time interval (years)
g_{t+1} = Population in the next t-year (number)
g_t = Population in the t-base year (number)

This geometric model was used because the population is believed to increase in a geometric fashion.

2.3.3 Relationship between demographic transition and population growth rate

The Granger causality statistics was used to ascertain the relationship between demographic

transition and population growth rate. In this case, the directionality of the Granger-causality between demographic transition and population growth rate is established. The primary model in Vector Autoregressive Regression forms are stated as in Gujarati and Dawn [31]:

$$Y_t = \propto_0 + \propto_1 \sum_{i=1}^{n} Y_{t-1} + \propto_2 \sum_{i=1}^{n} X_{t-1} + \mu_t \qquad (5)$$

$$X_t = \beta_0 + \beta_1 \sum_{i=1}^{n} X_{t-1} + \beta_2 \sum_{i=1}^{n} Y_{t-1} + \varepsilon_t \qquad (6)$$

Where,

Y_t = demographic transition over time (ratio of Births and Deaths)
X_t = rate of population growth over time
t = time trend
$\propto$ and β, = estimated parameters
μ_t and ε_t = error terms

In equations (5) and (6), If $\propto_2 \neq 0$ and $\beta_2 = 0$, there is a bilateral Granger causality between demographic transition and population growth. However, If $\propto_2 = 0$ and $\beta_2 \neq 0$, there is Granger causality between demographic transition. On the other hand, If $\propto_2 \neq 0$ and $\beta_2 \neq 0$, the causality is considered as mutual or bi-directional. In addition, there is no link between the demographic transition If $\propto_2 = 0$ and $\beta_2 = 0$.

2.4 Test of Hypotheses

Hypotheses of the study were realized from the results of objective (iv) using the Granger Causality Test.

3. RESULTS AND DISCUSSION

3.1 Stage of Demographic Transition in the Past Five Decades in Nigeria

Table 1 shows the estimated stage of demographic transition in the past five decades in Nigeria. Results showed that in the past five decades (1967-2017), the mean crude birth and death rates per 1,000 populations were 43.9 and 18.0 respectively, with 243.9% transition in the country. This implies that the birth rate in the past five decades was higher than death rates with 243.9% transitions above the 100% benchmark. Since the transition is above 100% benchmark, following Henslin [7] and Demographic Transition Model, this is an indication of high births and low

deaths (Birth rate was higher than death rate). This shows that in the past five decades (from 1967 to 2017), the country was at the second stage of demographic transition (stage II). In the second stage of demographic transition, the death rate declines without a corresponding fall in birth rates. This in turn produces an imbalance in births and deaths. Countries in this stage experience a large increase in population. This also implies that the country had moved out of the first stage (stage I) of demographic transition, where death and birth rates are high and roughly in balance (fluctuated rapidly according to natural events, such as famine, drought, and disease). In stage I, both birth and death rates tend to be very high and because both rates are approximately in balance, population growth is typically very slow. The society at this stage develops in accordance with the Malthusian paradigm, where food supply determines the level of population. In this case, any fluctuation in food supply resulting from droughts, pest invasion and/or improvement in technology especially improvement in agricultural practices, translate directly into population fluctuations.

The low death rate in stage II could be attributed to the improvement in food supply and healthcare services, resulting from the provision of basic health care services, portable water, improved personal hygiene and general health education, use of improved breeds and crop varieties, and access to technology in the country. The progress in public health and food supply therefore decreased child mortality, which stems from the improvement in antenatal services and increase in female literacy. According to Canning et al. [32], educating women increases their ability to make decisions about their own and their children's health.

According to Caldwell [16] countries in this stage include Yemen, Afghanistan, the Palestinian territories, Iraq and much of Sub-Saharan Africa; excluding South Africa, Zimbabwe, Botswana, Swaziland, Lesotho, Nambia, Kenya, Gabon and Ghana, which have begun to move into stage III of the demographic transition.

3.2 Stage of Demographic Transition in the Next Projected Five Decades in Nigeria

Table 2 shows the estimated stage of demographic transition in the next projected five decades in Nigeria. Results also showed that the expected crude births and deaths per 1,000 populations for the projected five decades (2018-2068) were 28.9 and 7.9 respectively, with expected transition of 365.8%. This implies that the birth rate in the next projected five decades will be higher than death rate with 365.8% transitions above the 100% benchmark. This also indicates that the country will still be at the second stage (stage II) of demographic transition in the next five decades (from 2018 to 2068). The past and projected stage (stage II) of demographic transition in the country is an indication of a growing population with spreading age base. Fig. 3 illustrates the second stage of demographic transition in the past and projected five decades in Nigeria, showing high birth and low death rates, and a population that increases at an increasing rate. The expected rapid drop in death rates (from 18.0 to 7.9, as shown in Tables 1 and 2) could be linked to the improvements in public health care services, sanitation and food supply, which in turn reduce disease and increase lifespan. This is in line with the report of Henslin [7] for developing countries, Nigeria inclusive.

The expected drop in births (from 43.9 to 28.9, shown in Tables 1 and 2) could also be linked to the improvement in female education and social status. Women's higher education empowers them to make decisions on their fertility [33]. Increasing female education changes the dynamics of family formation as it shortens the total reproductive life of a woman leading to a decreased Total Fertility Rate [34]. A lower fertility rate is often correlated with greater wealth and education [35]. Compared to lesser educated women, highly educated women tend to marry late, have a higher age at first birth and

Table 1. Estimated stage of demographic transition in the past five decades (1967-2017)

Items	Past five decades (1967-2017)
Crude Birth Rate	43.9
Crude Death Rate	18.0
Demographic Transition (DT)	2.439
DT%	243.9
Stage of Demographic Transition	Stage II

Source: Data from the United Nations Population Division, Department of Economic and Social Affairs [36].
Interpolated Demographic Data and STATA Computed, 2018

Table 2. Projected (Future) stage of demographic transition in Nigeria

Items	Projected five decades (2018-2068)
Crude Birth Rate	28.9
Crude Death Rate	7.9
Demographic Transition (DT)	3.658
DT%	365.8
Stage of Demographic Transition	Stage II

Source: Projected Data, United Nations Population Division, Department of Economic and Social Affairs [36], and STATA Computed, 2018
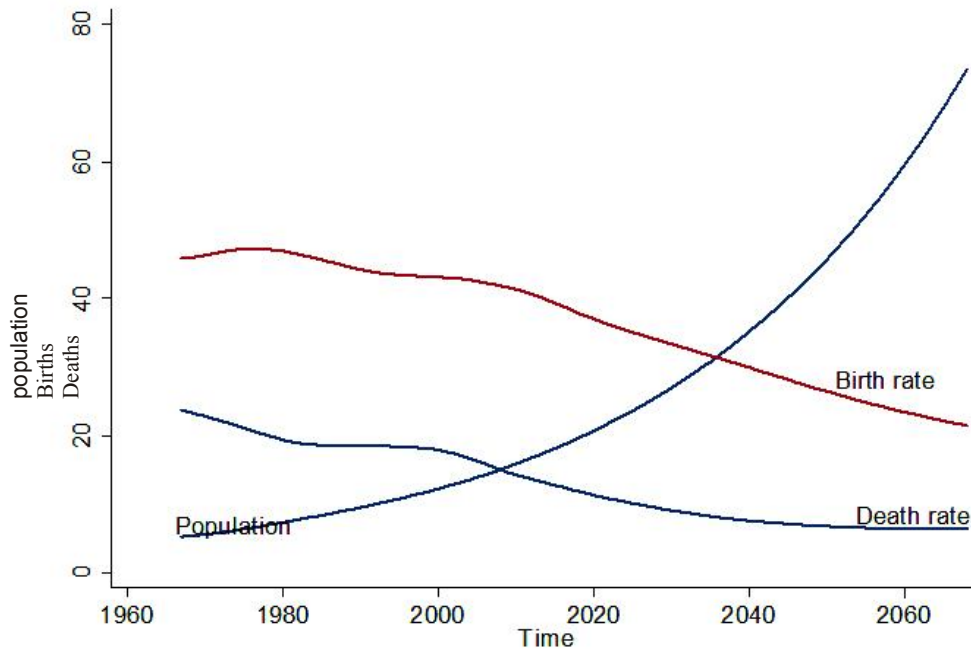

Fig. 3. Illustration of the second stage of demographic transition in the past and projected five decades in Nigeria
Source: Projected Data, United Nations Population Division, Department of Economic and Social Affairs [36] and STATA Computed, 2018

fewer children [37], and are more likely to be aware of modern contraceptives and to adopt new birth-control methods [38]. According to Cilliers [39] demographic changes such as a decline in child mortality and a rise in women's status and opportunities, resulting from modernization contribute to a very substantial reduction in total fertility rates and hence in population growth. Speeding up demographic transition in Sub-Saharan Africa, Nigeria inclusive, requires concerted actions such as female empowerment, in particular, eliminating gender inequality in education and boosting female enrolment and graduation rates to those of males at primary, secondary and tertiary levels; and improving the health of women and children by investing in basic infrastructure such

as the provision of clean water and improved sanitation [39].

3.3 Level of Population Growth

Table 3 shows the estimated population growth rate as demographic changes occur in the past (1967-2017) and projected (2018-2068) five decades in Nigeria. Results showed that the population growth rate in the past five decades (1967-2017) was 2.584 percent, while the projected growth rate in the next five decades (2018-2068) was 2.098 percent. This implies that the demographic changes in the past five decades (1967-2017) increased the population level by 2.584%, and it is expected that the population growth rate (2.098%) in the next five

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decades (from 2018 to 2068, as projected) will decrease by an average of 0.486% as shown in Fig. 4. Fig. 4 showed that the population growth rate rose at an increasing rate between 1967 and 1976, got to its maximum in 1977 and decreased at a decreasing rate between 1978 and 1983. The figure also showed that the projected population growth rate between 2018 and 2068 is expected to decrease at a decreasing rate.

This could be linked to the birth rate which increases at a decreasing rate (as shown in Fig. 1), resulting from the increase in female literacy, education and social status. This is in line with Sheikh and Loney [40] that linked the decreasing trend of total fertility rate to the increase in female literacy. According to Ghosh et al. [41], improvements in education play a role in ameliorating fertility choices in females.

Table 3. Population growth rate in the past (1967-2017) and projected (2018-2068) five decades in Nigeria

Time interval (Five decades)	Average population growth rate (%)
1967-2017	2.584
2018-2068	2.098
Difference	-0.486

Source: Projected Data, United Nations Population Division, Department of Economic and Social Affairs [36], and STATA Computed, 2018

Table 4. Granger causality wald tests for the relationship between demographic transition and population growth

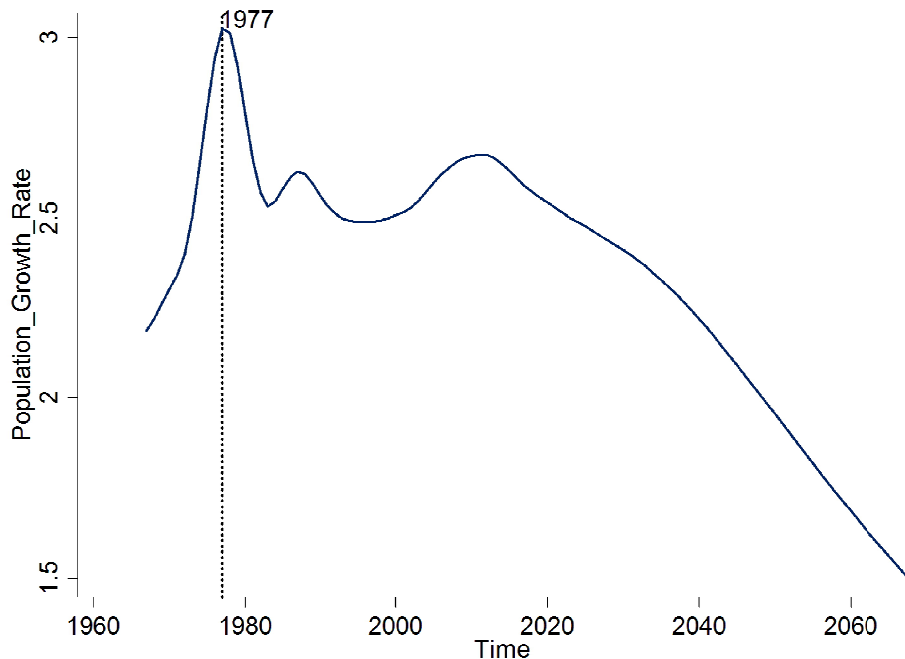| Equations	Excluded	Chi-square	P-value`
Population Growth	Demographic Transition	175.62	0.000
Population Growth	All	175.62	0.000
Demographic Transition	Population Growth	43.47	0.000
Demographic Transition	All*	43.47	0.000

Source: STATA 14 Output, 2018

Fig. 4. Illustration of the population growth rate over time in Nigeria
Source: Projected Data, United Nations Population Division, Department of Economic and Social Affairs [36] and STATA Computed, 2018

According to Aldieri and Vinci [37], highly educated women tend fewer children. Women's higher education empowers them to make decisions on their fertility [33]. Fertility issue reflects the extent to which people have the power and the means to make their own choices about the number, timing and spacing of pregnancies, and matters for societies because it can impede or accelerate progress towards greater prosperity, equitable and sustainable development, and well-being for all [42]. As reflected in the 2030 Agenda for Sustainable Development, reproductive health and reproductive rights are specific aims under one of the 17 Sustainable Development Goals and integral to realizing all the goals.

3.4 Relationship between Demographic Transition and Population Growth Rate

See Appendix for the tests of stationarity (Tables 5, 6 and 7). Table 4 shows the granger causality Wald tests for the relationship between demographic transition and population growth. The p-values showed that Demographic transition and all variables were significant at 1% levels, respectively. Therefore, the null hypothesis that lagged demographic transition does not granger causes population growth in the country was rejected. This led to the conclusion that lagged demographic transition granger causes population growth in the country. However, the p-values also showed that population growth and all variables were significant at 1% levels, respectively. Therefore, the null hypothesis that lagged population growth does not granger causes demographic transition in the country was also rejected. This also led to the conclusion that lagged population growth granger causes demographic transition in the country. This is an indication that there is a bi-directional causality between demographic transition and population growth rate. This implies that there is a mutual link between demographic transition and population growth, and demographic transition increases the prediction of population growth, and vice versa in the country.

4. CONCLUSION

Nigeria is currently at the second stage of demographic transition, and expected to remain at this stage (stage II) in the next five decades as births continue to be higher than deaths. The demographic changes (in the past five decades) resulting from a decline in death rates without a corresponding drop in birth rates, results to a large increase in population overtime in the country. The population growth rate however is expected to decrease in the next five decades. Finally, there is a mutual link between demographic transition and population growth, and demographic transition increases the prediction of population growth, and vice versa in the country.

5. RECOMMENDATIONS

Considering the fact that the country has been in stage two of demographic transition for the past five decades, and expected to remain at this stage in the next five decades, policy makers should focus on programs that will speed up the demographic transition to the next stage, through effort to reduce fertility rates. This will enable Sub-Saharan African countries, Nigeria inclusive to reap a demographic bonus and jumpstart economic development. Perhaps, issues relating to improving female literacy, raising access to comprehensive family planning services and overall health service delivery to stem mortality, may be very pertinent in this connection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ranganathan S, Swain RB, Sumpter DJT. The demographic transition and economic growth: Implications for development policy. Palgrave Communications. 2015;1: 15033.
    DOI: 10.1057/palcomms.2015.33
2. Tumbe C. Urbanisation, demographic transition and the growth of cities in India, 1870- 2020. The International Growth Centre (IGC) Working Paper; 2016.
    C-35205-INC-1
3. Merson MH. International Public Health: Diseases, Programs, Systems and Policies. (2nd ed.). Amazon.com. USA: Jones and Bartlett Publishers Inc; 2006.
4. Cahu P, Fall F, Pongou, R. Demographic transition in Africa: The Polygyny and Fertility Nexus. Working Paper. 2012;1-26.
5. Tacoli C, McGranahan G, Satterthwaite D. Urbanization, Rural–urban Migratio and

Urban Poverty. Human Settlements Group International Institute for Environment and Development London. Background Paper. 2014;1-32.

6. Megeri MN, Kumar GM. Demographic transition and economic development in Karnataka. Journal of Quantitative Economics. 2018;16(1):173-183.

7. Henslin JM. Essentials of Sociology: A Down-to- Earth Approach. (8thed.). U.S.A. Allyn and Bacon; 2009.

8. Myrskylä, Mikko, Hans-Peter Kohler, Billari F. Advances in development reverse fertility declines," Nature. 2009;460(6): 741–743.

9. Baudelle G, Olivier D. Changement Global, Mondialisation et Modèle De Transition Démographique: Réflexion sur une exception française parmi les pays développés. Historiens et Géographes. 2006;98;177–204.

10. UNFPA. Sustainable development and population dynamics: Placing People at the Centre; 2013.
Available:https://www.unfpa.org/press/sustainable-development-and-population-dynamics-placing-people-centre

11. Eastwood R, Lipton M. Demographic transition in sub-Saharan Africa: How big will the economic dividend be? Population Studies. 2011;127. iFirst article:1-27

12. Binswanger-Mkhize HP, Savastano S. Agricultural intensification: The status in six African countries. Food Policy. 2017;67: 26–40.

13. Ogunbameru OA. (Ed.). Sociology: A contemporary science of human interaction in society. Ibadan, Nigeria: Penthouse Publications (Nig.); 2009.

14. Rowland DT. Demographic Methods and Concepts. New York. Oxford University Press Inc; 2003.

15. Akokuwebe ME, Okunola RA. Demographic transition and rural development in Nigeria Developing Country Studies, 2015;5(6).
[ISSN 2224-607X (Paper) ISSN 2225-0565 (Online)

16. Caldwell JC, Caldwell BK, Caldwell P, McDonald PF, Schindlmayr T. Demographic Transition Theory. Dordrecht, the Netherlands: Springer. 2006;418.

17. Weeks JR. Population: An Introduction to Concepts and Issues. Cengage Learning. 2014;94–97.

18. Lines CJ, Bolwell LH, Norman M. Revised GCSE Geography. 6th edn, London: Letts Educational. 1997;1-240.

19. Ocean Data and Information Network for Africa (ODINAFRICA). Nigeria; 2014.
Available:http://wwwodinafricaorg/indexphp/Nigeria

20. National Bureau of Statistics. Nigeria Poverty Assessment. NBS in Collaboration with World Bank and DFID. 2007;38-185.

21. World Factbook. Rank Order; 2017.
Available:http://wwwciagov/library/publications/theworldfactbook/rankorder/2147rankhtml

22. Federal Research Division. Country Profile: Nigeria; 2008.
Available:http://lcweb2locgov/frd/cs/profiles/Nigeriapdf

23. World Bank and United Nation Population Division; 2019.

24. UNICEF. The draft country programme document for Nigeria 2014-2017. 2013; E/ICEF/2013/P/L.7.

25. National Population Commission: In Central Bank of Nigeria. CBN Annual Report December 31st. CBN Corporate. Head Office, Central Business District Garki, Abuja. 2011;123-147, 258-267.

26. Akinyemi AI, Isiugo-Abanihe UC. Demographic dynamics and development in Nigeria African Population Studies. 2014;240.

27. World factbook. Nigeria People - Nigeria Population Pyramid-Age and Sex Structure; 2013.
Available:http://www.immigrationusa.com/world_fact_book_2012/nigeria/nigeria_people.html. CIA world Factbook: p. 3.

28. World factbook. Nigeria People- Nigeria Age Structure. CIA world Factbook; 2012.
Available:http://www.immigrationusa.com/world_fact_book_2012/nigeria/nigeria_people.html

29. National Population Commission (NPC) and ICF Macro. Nigeria Demographic and Health Survey 2008. Abuja, Nigeria: National Population Commission and ICF Macro; 2009.
Available:https://dhsprogram.com/pubs/pdf/FR222/FR222.pdf

30. Jedwab R, Christiaensen L, Gindelsky M. Demography, urbanization and development: Rural push, urban pull and urban push? Policy Research Working Paper, Washington, DC: World Bank Group. 2015;7333.

31. Gujarati DN, Dawn CP. Basic Econometric, the fifth edition. McGraw- Hill International Edition, New York, USA; 2009.

32. Canning D, Sangeeta R, Yazbeck AS. Africa's Demographic Transition: Dividend or Disaster? Overview booklet. Africa Development Forum series. World Bank: Washington, DC; 2015.

33. Chicoine LE. Education and Fertility: Evidence from a Policy Change in Kenya" Institute for the Study of Labor (IZA), Bonn; 2012.
Available:http://econpapers.repec.org/p*ap er/izaizadps/dp6778.htm

34. Gakidou E, Cowling K, Lozano R, Murray CJL. Increased educational attainment and its effect on child mortality in 175 countries between 1970 and 2009: a systematic analysis. Lancet Lond Engl. 2010;376: 959–74.

35. Murphy M. Cross-national patterns of intergenerational continuities in childbearing in developed countries. Biodemography Soc Biol. 2013;59:101–26.

36. United Nations Population Division, Department of Economic and Social Affairs. World Population Prospects: The 2017 Revision: Interpolated Demographic Indicators byregion, subregion and country annually for 1950-2099.
POP/DB/WPP/Rev 2017/INT/F01

37. Aldieri L, Vinci CP. Education and fertility: an investigation into Italian families. Int. J. Soc. Econ. 2012;39:254–63.

38. Kim, J. Female education and its impact on fertility. IZA World of Labour. 2016;228:1 10.
DOI:10.15185/izawol.228

39. Cillier J. Getting to Africa's demographic dividend. Institute for Security Studies. South Africa, ISS Africa Report 13. 2018;1-31.

40. Sheikh SM, Loney T. Is educating girls the best investment for South Asia? Association Between Female Education and Fertility Choices in South Asia: A Systematic Review of the Literature. Front. Public Health, 2018;6:172.

41. Ghosh R, Chakravarti P, Mansi K. Women's empowerment and education: Panchayats and women's self-help groups in India. Policy Futures Educ. 2015;13: 294–314.

42. United Nations Population Fund, UNFPA. The Power of Choice: Reproductive Rights and the Demographic Transition. United Nations Population Fund605 Third Avenue New York, NY 10158; 2018.

APPENDIX

Unit Root, Co-integration and Error Correction Mechanism for Demographic Transition and Population Growth Rate

Unit Root Tests

Table 5 shows the results of the three Dickey Fuller (DF) models with intercept, no trend/no intercept and trend/intercept, for the unit root tests for demographic transition and population growth rate. The three Dickey Fuller models confirmed that the time series variable demographic transition was stationary at 1%, 5% and 10% levels, while population growth rate at its level has t-value (ADF test statistics) less than the critical values at 1%, 5% and 10%. This therefore results to accepting the null hypothesis that the population growth rate has unit root in the series. This implies that the variable, population growth rate, is non-stationary. Results showed that taking the third difference of population growth and no difference of demographic transition, increased the t-values (ADF test Statistics), which were greater than the critical values at 1%, 5% and 10% levels, respectively for the three DF models. This however leads to the conclusion that population growth is integrated of order three, while demographic transition is integrated of order zero. This results to the rejection of the null hypothesis and the acceptance of the alternative that both series have no unit root, and are stationary.

Table 5. Results of ADF unit root tests for demographic transition and population growth rates

Variables	Model 1 (Intercept)				Model 2 (No trend, no intercept)				Model 3 (Trend and Intercept)				Order of differencing
	ADF Statistic	Critical Values 1%	5%	10%	ADF Statistic	Critical Values 1%	5%	10%	ADF Statistic	Critical Values 1%	5%	10%	
Demographic Transition	-3.68	-3.51	-2.89	-2.58	3.68	-2.60	-1.95	-1.61	5.08	-4.04	-3.45	-3.15	I(0)
Population Growth	-4.29	-3.51	-2.89	-2.58	-4.31	-2.60	-1.95	-1.61	-4.26	-4.04	-3.45	-3.15	I(3)

Source: STATA 14 Output, 2018

Johansen Co-integration Tests

Table 6 shows the results of Johansen co-integration tests for demographic transition and population growth rate. Results showed that for none (0) hypothesis (there is no co-integrating model), the Trace statistics (44.443) and Max statistic (43.387) values were significant at 5% critical. Therefore, the null hypothesis that there is no co-integrating model was rejected since the Trace and Max statistic values are greater than the 5% critical value. Results also showed that for at most one co-integrating hypothesis (at most 1), the Trace (1.0456) and max (1.0456) were not significant at 5% critical levels. Therefore, the null hypothesis that there is one co-integrating model was accepted. This implies that demographic transition and population growth rate are co-integrated, and have long run equilibrium relationship.

Table 6. Results of Johansen co-integration tests for demographic transition and population growth rate

Hypotheses	Trace statistics		Max statistics		H$_0$: Decision
	Value	5% critical	Value	5% critical	
None (0)*	44.433	15.41	43.387	14.07	Rejected
At most 1	1.0456	3.76	1.0456	3.76	Accepted

significant at 5%
Source: STATA 14 Output, 2018

Error Correction Mechanism

Table 7 shows the long run and short run causality between demographic transition and population growth rate in the country. Results showed that the error correction (EC) coefficient (-2.54) was

negative and statistically significant at 1% level. This is an indication of long run causality running from demographic transition to population growth at a speed of 2.54% annually. The error correction coefficient represents the long run equilibrium between demographic transition and population growth rate. It also shows the rate at which it corrects the previous period disequilibrium of the system, and the rate at which the system restores back to equilibrium. This implies that the system corrects the previous period disequilibrium (speed of adjustment) at a speed of 2.54% annually. Results also showed that the short run coefficient (0.313) was positive and statistically significant at 10% level. This is an indication of short run equilibrium. It implies that in the short run, the system corrects its previous period disequilibrium at a speed of 0.313% between population growth and demographic transition. The chi-square value (69.45) of the post estimation test which was significant at 1% level further confirmed that there is a short run causality running from demographic transition and population growth rate, at a speed of 0.313% per annum. However, the diagnostic check for autocorrelation showed that the chi-square value (6.117) was not significant. Therefore, the null hypothesis that there is no autocorrelation was accepted. This implies that there is no autocorrelation at lag order specified. The chi-squared values of demographic transition (1.006) and population growth rate (0.118) for the Jarque-Bera test for normally distributed disturbances were not significant. Therefore, the null hypothesis that residual is normally distributed was accepted.

Table 7. Long run and short run causality between demographic transition and population growth rate

Equation (lag 24)	Coefficient	t-statistics	P-value
Long run (EC)	-2.5371*	-3.75	0.000
Short run	0.31317**	1.76	0.066
Post estimation test for short run causality			
Chi-square (lag 23)	69.45		
Prob>chi-square	0.0000		
Diagnostic test for autocorrelation			
Lag Chi-square	P-value		
24 6.117	0.48252		
Jarque-Bera test for normally distributed disturbances			
Variables	**Chi-squared**	**P-value**	
Demographic Transition	1.006	0.215	
Population Growth	0.118	0.415	
All	1.124	0.332	

*significant at 1%, **significant at 10%*
Source: STATA 14 Output, 2018

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