CHILDREN'S QUALITY AND QUANTITY IN NIGERIA: A GRANGER CAUSALITY ANALYSIS

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ABSTRACT

This research investigated the cointegration and causal relationships between children's quality and quantity in Nigeria. The research was based on secondary data obtained from the World Development Indicator database (1980-2014), United Nations Statistics Division's Statistical Yearbook, and the UNESCO Institute for statistics online database. Children's quality denoted by the education of the child was proxied by government education expenditure and life expectancy rate, while the quantity of the children denoted by the size of the family was proxied by total fertility rate, infant mortality rate, and the adolescent fertility rate. For analysis, Augmented Dickey Fuller unit root test, Johansen-Juselius cointegration analysis, and Granger causality tests were conducted. Johansen-Juselius cointegration test results indicate that there is a long-term relationship among the selected variables. Meanwhile, the Granger causality test shows that the causation between the quality and quantity of children is both unidirectional and bi-directional depending on the variable of the quantity of children. The quantity of the children is the cause in the unidirectional causation. Furthermore, a trade-off is established between the quality and quantity of children. Therefore, the policies of the government in encouraging and promoting the reduction of the rate of fertility should be pursued further for an increased level of education of the child.

Keywords: *quality, quantity, children quantity, Nigeria, cointegration, Granger-causality*

INTRODUCTION

The interplay between family size and the child's education has gained ground since the 1960s. This has been considered by many another researchers. The relationship shows an inverse mutual movement between education and fertility. The basis for the argument is that subject is given budget constraint. When there is an exogenous change to the number of children born, it affects the optimal amount of education given to the children, and an exogenous change to the amount of education given to the children affects the optimal number of children born. The model shows an interaction between quantity and quality of children in the budget constraint which leads to rising marginal costs of quality with regard to quantity. The strong negative relationship observes between children's education and demand for children by parents has raised the quality and quantity trade off hypothesis. The hypothesis states that as a result of increasing rate of return on human capital investment in the form of education, there is a change in the fertility pattern in favor of lower fertility and more investment in human capital per child. Since the decisions of fertility level and child's educational investment are made jointly by parents, those who prefer the quality to quantity of children will choose to have fewer children so they can be educated better, or vice versa.

Another way of considering the negative relationship between the two phenomena is by looking at the effect of the mother's education on her choice of the family size. Female education especially supports the highly effective weapon for combating high fertility rate and consequential

population growth. It is believed that as average income and social status rise, female parents choose to have fewer children so they can provide more and better education. Therefore, literature is replete with the research on the correlation between the education of mother and her rate of fertility. There is the view that an improved educational opportunity, particularly for women, has become the most important means to lower fertility rates in developing nations. For instance, in discussing the role of female education on fertility, Cohen (2008) has pointed out that in Ethiopia, women with no formal education have on average six children, while those with primary education have five children, and those with at least secondary education have only two children. Female's education increases age in marriage, employment opportunities outside the home, social mobility, husband-wife communication, exposure to contraceptive information and devices, reduced religiosity, infant mortality, and acted through these and the likes which affected fertility rate.

Several empirical research has confirmed stronger and more consistent about negative relationship between education and fertility than other single variables. It includes Black *et al.* (2005), Maralani (2008), Angrist *et al.* (2010), de Haan (2010), Åslund and Grönqvist (2010), Prahhan (2015), and Baranowska-Rataj *et al*. (2015). Black *et al.* (2005) has examined the effects of family size and birth order on the educational attainment of children in Indonesia. Their research is based on a data set which is in the whole population of Norway over an extended period of time. They establish a negative correlation between family size and children's education and also suggest that economic models should incorporate differences within families, the fertility, and child production in addition to differences across families.

However, Maralani (2008) who based his study on Indonesia, which is the fourth populous nation in the world, has developed rapidly argued that the relationship between family size and children's schooling depended on the contextual factors. Those might occur with socioeconomic development. Exploring models used instrumental variables to address the potential endogeneity of fertility shows that the association between family size and children's schooling is positive for older ones, but it is negative for more recent cohorts in urban areas. Meanwhile, the rural areas show no significant association between family size and children's schooling for any cohort. Furthermore, Angrist *et al*. (2006) has stated that family size has a negative association with educational attainment among Israeli Jews, whereas the Israeli Muslims' family size and educational attainment are not associated. They are less advantaged socio-economically who live in less urban settings, has extended kinship networks, and much higher fertility rates had. He suggests that when there are more siblings to share household and labor market work with, there might be more resources for schooling children in certain contexts or certain stages of development. Meanwhile, in some settings, the quality and quantity trade-off might not hold, so that the desire to have better-educated children might not necessarily lead parents to choose smaller families. On the other hand, Baranowska-Rataj *et al*. (2015) has agreed that children who have many siblings receive less support from parents than children who are raised in small families.

Although many research concern with the effect of mother's education on her fertility rate decision, only a few researchers in Nigeria have addressed how changes in the preference for the education of the children has affected the number of children born. Testing the quality and quantity of children relationship in Nigeria is tremendous policy relevance because the population has been a rather sensitive and controversial issue in the country which is the most populous country in Africa and the ninth populous country in the world. Furthermore, the age structure of the population reflects a large proportion of children and young people whose age are under 15 years about 45 percent of the total population. Also, the validity check of quality and quantity model is more relevant in developing countries such as Nigeria because of the resource constraint argument inherent in the model.

Osili and Long (2008) use the number of women that give birth before age 15 and 25 as the key of dependent variables. The results support the earlier findings that said the education and the number of children ever born are negatively related to all levels of schooling. However, the result

shows that the negative effect of schooling is only statistically significant for individuals who have completed more than four years of schooling. The results further indicate that the UPE cohort is about 9-11 percentage points less likely to have a first birth before age 15. And the UPE program has a negative and statistically significant on the number of births before age 25 thereby reducing the number of births before age 25. The analysis suggests that the increasing education by one year reduces fertility by 0,26 births.

Akpotu *et al.* (2007) has examined the family size, income, and the employment status of parents as predictors of the investment in children's education in the South West Nigeria. Their findings indicate an inadequate positive and statistically significant relationship between investment in children's education, the family size, and parents' income. As a way of improving on the result, the study suggests the inclusion of other variables such as sociological, environmental, demographic, and urbanization in a further study. Also, Akpotu (2008) has examined the relationship between the level of educational attainment of families and the family size. Questionnaires are used to elicit information from the married couples in the 18 states in the south of the River Niger that is generally called by the Southern Nigeria. The analysis, however, reveals that education is found to be more inversely related to fertility among women and urban dwellers than men and rural dwellers. He identifies Nigerian's love for children, their polygamous nature, irrespective of their educational attainment, and the needs for a particular sex of children, among others as the factors that are responsible for enlarged family size.

Nduka *et al*. (2014) has examined the desired family size and the associated factors among the people of Umuahia in Southern East, Nigeria. They administered the pre tested coded questionnaire and analyzed the data by using descriptive and inferential statistics using SPSS. They conclude that parents' education and religion are the major determinants of family size choice.

Alonge (2014) has also determined the major decision maker between the husband and wife in the Ijesa sub ethnic group of Yoruba in Nigeria, and the type of decision is jointly made by them. It employs both qualitative and quantitative techniques which involve a random selection of 17 enumeration areas and 1,594 ever married women of child bearing age. His findings show that husbands are more involved in making fertility decisions as regards the number of children and when to have them in the study area.

METHODS

The researchers distinguish two directions of causation to assess whether there is indeed a trade-off between fertility and education in Nigeria, where the fertility rate is a function of education and also where education is a function of fertility rate. This starts with the exploration of the unit root test for all the variables considered using the Augmented Dickey-Fuller (ADF) test to determine whether the series is stationary. The study uses annual secondary data on Total Fertility Rate (Fert), Infant Mortality Rate (IMR), and Adolescent Fertility Rate (Afr) to proxy the number of children which connotes the quantity. Education Expenditure and Life Expectancy rate are used to proxy the education of children which connotes the quality of children. Total fertility rate (Fer) is the number of children that would be born to a woman if she lives till the end of her childbearing years and bear children in accordance with current age-specific fertility rates. Infant mortality rate is the number of infants dying before age one, per 1.000 live births in a particular year. Adolescent fertility rate is births per 1.000 women ages 15-19 years. Education expenditure as a percentage of Gross National Income refers to the current operating expenditures of government in education, including wages and salaries, and excluding capital investments in buildings and equipment. While life expectancy at birth is defined as the average number of years that a newborn could expect to live if he or she is to pass

through life subject to the age-specific mortality rates of a given period. Ben-Porath (1967) shows theoretically that longer life expectancy implies higher education with the assertion that individuals with a longer time horizon invest more in schooling since the period during which they can benefit from their returns on the investment is longer. All the data cover the period 1980 to 2014 are obtained from World Development Indicator (WDI) except education expenditure which is sourced from index Mundi's site (World Bank staff estimates using data from the United Nations Statistics Division's Statistical Yearbook and the UNESCO Institute for Statistics online database).

The researchers do the unit root test. The most economic series appear to be non-stationary (Nelson and Plosser, 1982). The common test statistics for stationarity are Augmented Dickey Fuller (ADF) test (1979) and the Phillips-Perron (PP) test (1988). ADF test is applied to examine the stationarity of the series. The null hypothesis is rejected if the calculated t-value (ADF statistics) lies to the left of the relevant critical value. The test regression is given as:

$$y_t = b y_{t-1} + e_t \quad (1)$$

Where b is the coefficient of the lagged observed time series. And the hypothesis is given as:

$H_0 : \beta = 1$ There is a unit root, implying that y_t is non-stationary

$H_0 : \beta < 1$ There is no unit root; therefore, the series is stationary

Next is Pairwise Granger Causality Tests (PGCT). The simplest case of PGCT is a bivariate Vector Auto-Regressive (VAR) model where there are only two variables, y_{1t} and y_{2t}. The model is represented as:

$$y_{1t} = \beta_{10} + \beta_{11} y_{1t-1} + ... + \beta_{1k} y_{1t-1} + \alpha_{11} y_{2t-1} + ... + \alpha_{1k} y_{2t-k} + \mu_{1t} \quad (2)$$

$$y_{2t} = \beta_{20} + \beta_{21} y_{2t-1} + ... + \beta_{2k} y_{2t-1} + \alpha_{21} y_{2t-1} + ... + \alpha_{2k} y_{2t-k} + \mu_{2t} \quad (3)$$

Where μ_{it} is a white noise disturbance term with $E(\mu_{it}) = 0$ and $E(\mu_{1t}\mu_{2t}) = 0, i = 1, 2, ...$

The VAR model is employed to check if there is Granger causality between children's quality and quantity.

Table 1 shows hypotheses for the series that are formulated with the null hypotheses stating that each of the variables is non-stationary against its respective alternatives. The unit root test reveals that only one of the variables (Eduexp) is stationary at levels, while others become stationary at the first differencing (IMR) and the second stage differencing (Lifeexp, Fert, and Afr).

Table 1 Augmented Dickey-Fuller (ADF) Test Results

Variables	Form	P-value	ADF test statistcs	Critical-Value	
				1%	5%
Eduexp	Level	0,0000	-11,2233	-3,6463	-2,954
	First Difference	0,0000	8,9903	-3,6463	-2,9954
	Second Difference	0,0001	-19,0386	-3,6537	-2,9571
Lifeexp	Level	0,9896	0,6707	-3,6463	-2,9540
	First Difference	0,7241	-1,0480	-3,6463	-2,9540
	Second Difference	0,0001	-5,6402	-3,6537	-2,9571
Fert	Level	0,4804	-1,5804	-3,6617	-2,9604
	First Difference	0,7115	-1,0758	-3,6793	-2,9678
	Second Difference	0,0000	-11,9824	-3,6793	-2,9678

Table 1 Augmented Dickey-Fuller (ADF) Test Results (Continued)

Variables	Form	P-value	ADF test statistcs	Critical-Value	
				1%	5%
Afr	Level	0,9889	0,6458	-3,6463	-2,9540
	First Difference	0,3358	-1,8830	-3,6463	-2,9540
	Second Difference	0,0000	-6,1042	-3,6537	-2,9571
IMR	Level	0,2173	-2,1793	-3,6617	-2,9604
	First Difference	0,0000	-5,7526	-3,6702	-2,9639
	Second Difference	0,0713	-2,8016	-3,6999	-2,9763

Source: Authors (2016)

Table 2 provides the results of Johansen-Juselius cointegration tests for the series. The necessary critical values for the test statistics are provided by Johansen and Juselius (1990). The results indicate that there are five co-integrating vectors in the model, implying that the variables Afr, Fert, IMR, Lifeexp, and Educexp share the same stochastic trend and tend to move together. This means that there is a long-run relationship between the variables.

Table 2 Johansen-Juselius Cointegration Test Results

	λ_{trace}			$\lambda_{\max}$		
No of CE	**Test stat.**	**C. values**	**p-values**	**Test stat.**	**C. values**	**p-values**
$r = 0$	197,0084	69,81889	0,0000	0,956677	100,4503	0,0000
$r \leq 1$	96,55805	47,85613	0,0000	0,691678	37,65153	0,0018
$r \leq 2$	58,90652	29,79707	0,0000	0,610023	30,13333	0,0021
$r \leq 3$	28,77318	15,49471	0,0003	0,435186	18,28029	0,0110
$r \leq 4$	10,49290	3,841466	0,0012	0,279567	10,49290	0,0012

Source: Authors (2016)

Table 3 reports the Granger causality test shows each possible pairs of variables have either unidirectional or bi-directional causality between them. Pairwise comparison tests at 5% level of significance on the six possible pairs of variables that are carried out and the results are as presented. The decision rule is if the coefficients of both cases in a pair are not significant, there is no causality between them and if both coefficients are significant, and then there is bidirectional causality between them. However, if one of the coefficients is significant and the other case is not, then the former cause the later, and it is termed unidirectional.

Table 3 Pairwise Granger Causality Test Results

Pairs	Null Hypothesis	F-stat	P-value	Decision	Types of Causality
1	Afr does not cause Eduexp	4,05352	0,0284	Reject H_o	Bidirectional
	Eduexp does not cause Afr	3,30212	0,0516	Reject H_o	
2	Fert does not cause Eduexp	2,19015	0,1314	Do Not Reject H_o	No Causality
	Eduexp does not cause Fert	1,39041	0,2662	Do Not Reject H_o	
3	IMR does not cause Eduexp	0,56554	0,5744	Do Not Reject H_o	No Causality
	Eduexp does not cause IMR	0,58543	0,5635	Do Not Reject H_o	
4	Afr does not cause Lifeexp	8,38775	0,0014	Reject H_o	Bidirectional
	Lifeexp does not cause Afr	6,19464	0,0059	Reject H_o	

Table 3 Pairwise Granger Causality Test Results (Continued)

Pairs	Null Hypothesis	F-stat	P-value	Decision	Types of Causality
5	Fert does not cause Lifeexp	9,11644	0,0009	Reject H_o	Unidirectional
	Lifeexp does not cause Fert	2,75030	0,0818	Do Not Reject H_o	
6	IMR does not cause Lifeexp	3,67895	0,0381	Reject H_o	Unidirectional
	Lifeexp does not cause IMR	1,49674	0,2412	Do Not Reject H_o	

Source: Authors (2016)

As shown in Table 3, in the first pair of variables of the pairwise Granger causality test (where Adolescent fertility rate is used to proxy the number of children and educational expenditure as a percentage of Gross National Income was used to proxy education), the result indicates a bidirectional causality relationship between the number of children and the education of children. This implies that quality of children predicts the quantity, and the quantity as well predicts the quality in Nigeria during the period of the study simultaneously. This is consistence with the result obtained by Becker et al. (2010) who is using the census-based dataset of 334 Prussian counties established that causation between fertility and education run both ways. However, the result of the second and the third pairs of variables of the causal relationship indicates that there is no causality between the two phenomena when total fertility rate and infant mortality rate are used to proxy the number of children.

In Table 4, the result of correlation matrix further shows that the variables of the quantity and quality of children move in the same direction of causation and they are significant. By implication, a reduction in the adolescent fertility rate induces a reduction in the government expenditure on education, while at the same time a considered increase of government expenditure on education could be a motivation for a higher rate of the adolescent fertility.

Table 4 Correlation Matrix

	Afr	EduExp	Fert	IMR	Lifeexp
Afr	1	0,84	0,91	0,63	-0,80
EduExp	0,84	1	0,84	0,46	-0,41
Fert	0,91	0,84	1	0,82	-0,58
IMR	0,63	0,46	0,82	1	-0,47
Lifeexp	-0,80	-0,41	-0,58	-0,47	1

Source: Authors (2016)

In the same way in the fourth pair of variables, a bidirectional causation is observed between the two phenomena when life expectancy is used as a proxy of education and Adolescent fertility rate as a proxy for the number of children. However, the result of the correlation matrix that is shown in Table 4 confirms inverse relationships that are significant between the variables. This indicates a trade-off between the quantity and the quality of children, implying that as the rate of adolescent fertility is lowered, the life expectancy rate increases. This is because there are fewer children to cater for as a result of lowered fertility rate, so more resources are devoted to educational investments which have the capability of prolonging life. At the same time, as the expectation of living longer increases as a result of more education or the other way round, the need for more children is reduced. This corroborates the results of Doepke (2004) and Bleakley & Lange (2009) that in accordance with other previous authors established the negative relationship between the number of children and their education.

Furthermore, the causal relationship in the fifth and sixth pairs of variables suggests a unidirectional causality running from the variables of quantity to the variable of quality when total fertility rate and infant mortality rate are used to proxy the quantity, and quality is proxied by life expectancy rate. The causal relationship is also shown to be inversed as confirmed by the correlation matrix result in Table 4. This is in accordance with the result of Darrat and Yousef (2004) who established the notion that it is possible that rapid population expansion as a result of high fertility rate could hamper the process of educational accumulation due to the consequential demand pressures on scarce educational resources and infrastructure.

CONCLUSIONS

The study, therefore, shows that indeed there is existed the causal relationship between quantity and quality of children in Nigeria during the period of the study. The results, in particular, establish a trade-off between the quality and the quantity of children. Considering the significant implications of the education of the child either as the cause or effect, the government of Nigeria should intensify its effort in ensuring that policies that will encourage and promote a further lowering of the quantity of children are put in place to be able to improve the quality of the child. Availability of data is a great issue in quantifying this crucial relationship. For the purpose of future research in this topic area, the government should see to the issue of data.

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