Amity Journal of Economics
3 (1), (76-88)

Female Literacy and Fertility Rate in Sub Saharan Africa

Ehimhen Emmanuel Eshorameh
University of Benin, Benin City, Nigeria

Abstract

This study investigates Female literacy and fertility rate in sub Saharan Africa. Using annual panel data for the period 1995 to 2015, the Fixed Effect and Generalized Method of Moments (GMM) was utilized. The result obtained revealed that high level of female literacy reduces the rate of fertility within sub-Saharan Africa region significantly. Therefore, it is recommended that the government should take full responsibility of improving the rate of female literacy by enforcing compulsory education for the girl child, especially in countries where female literacy rate is very low.

Keywords: Female Literacy, Fertility Rate, Sub-Saharan Africa, Generalized Method of Moments

JEL Classification: I1, I2

Paper Classification: Research Paper

Introduction

One major challenge of underdeveloped nations and countries within the Sub-Saharan Africa region (SSA) is increasing population that outruns resources necessary to cater to the people. Following this, a low fertility rates has been advocated as a measure of population control. In SSA, some socio-economic factors that have been identified to alter demographic behaviour, especially fertility, include educational attainment, religious conviction, rate of contraceptive usage, level of abortion, effect of immigration, adolescent fertility, child labor, female involvement in labor force and state policies. In addition to these, Eloundou, Stokes and Cornell (2000) further identified female education to be an important factor.

Despite the use of some of these control measures, fertility rates are relatively high in countries within the Sub Saharan region when compared to countries outside the region and developed countries as well. Although, a decline has been recorded over the years which has been sustained with huge long-term demographic significance, this has not nullified the drawbacks in SSA countries when compared with advanced countries of the world. This decline in fertility results from rising levels of urbanization and education, changes in the economy, and declining mortality among others.

Bongaarts and Casterline (2013) noted that fertility rate falls generally as countries develops and a strong inverse correlation exist between development indicators and fertility in contemporary societies. This invariably implies that countries characterized by relatively low levels of social and economic development such as most countries within the Sub-Saharan region experience high fertility. It is reported that Africa records the highest rate of fertility among other continents of the world with Niger, Angola, Mali, Burundi, Somalia, Burkina Faso and Uganda as the leading countries. More specifically, World Factbook (2017) recorded a rate of 6.49 for Niger, 6.16 for Angola, 6.01, 5.99 for Mali, while Burundi and Somalia were 5.80 and 5.71 respectively.

Literature Review

Fertility rate as a component of population growth shows the roots and upshots of economic as well as social developments. One prominent social factor that seems to determine fertility rate is education. Educational attainment has contributed to the decrease in fertility rate and to many, education is seen as a pivotal factor that influences childbearing desires. Research showing continual down trend in fertility in SSA has proven education and other determinants of fertility to be effective as control mechanism.

Conceptual Clarification on Fertility Rate

Total fertility rate is the mean amount of children given birth by a woman in her lifetime, assuming her childbearing conforms to her age specific fertility rate every year of her childbearing years (typically, age 15 to 45). Put differently, it is the sum of all the children that every woman would bear if she lives up to the end of her child-bearing years given that her child bearing aligns with the existing age-specific fertility rates. The computation of total fertility rate is derived by talking the sum of the age-specific fertility rates over a five-year interval.

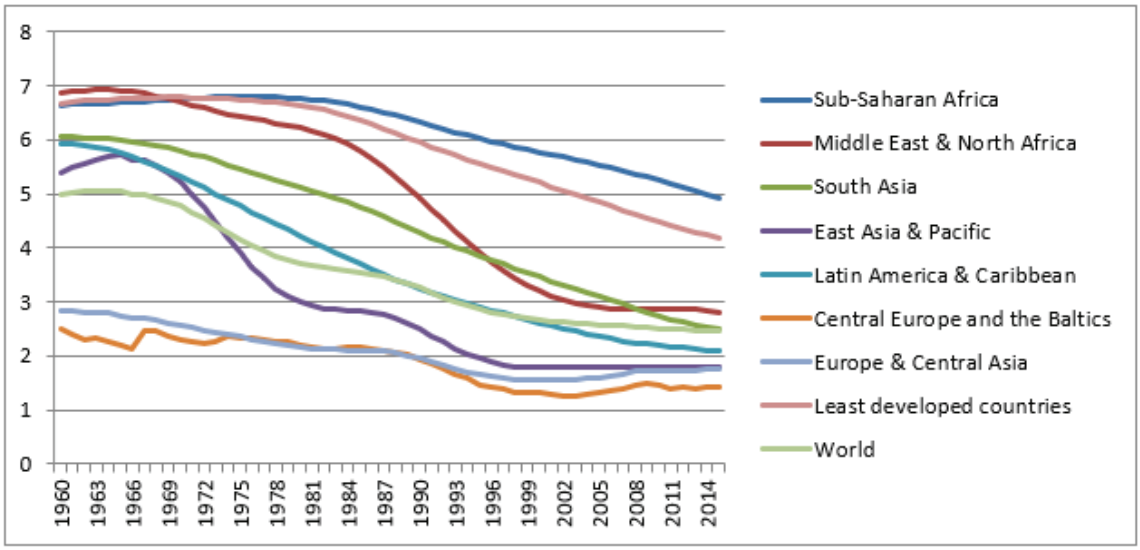
Bulatao and Ronald (1983) opined that fertility is established by the demand and supply of children, as well as fertility regulation costs which include both material and non-material outlays. The determinants of the supply of children are natural fertility and children rate of survival while the demand for children is affected by direct economic costs and benefits of children, income and wealth, as well as preferences and traditions.

Furthermore, other socio-cultural considerations that influence supply, demand and regulation costs includes marriage arrangements. In a broader sense, examined the pattern of sexual unions, with special interest on their composition; be it polygamy or monogamy. In addition to these is the nature of family (nuclear and extended) formations and dissolutions (Bulatao & Ronald, 1983).

Trend Analysis of Fertility Rate in SSA

In the early 1960s fertility levels were high in all the regions apart from Latin America and Caribbean, and Central Europe and the Baltics. This has however declined over the years with Sub Saharan Africa retaining its high rates as compared to other regions. As seen in the Figure-1 below, high fertility rates are recorded in developing regions like the Sub-Saharan Africa and least developed countries and low for the most part of industrialized regions, notably in Europe, Central Asia, Central Europe and the Baltics, East Asia and Pacific. Meanwhile, regions like Latin America, Caribbean, South Asia, Middle East and North Africa maintained a rate between 2 and 2.9.

Figure 1: Trend Analysis of Fertility Rate



Source: Derived from WDI data, 2018

Female Education and Fertility Rate

One prominent socioeconomic determinant of fertility that has received considerable attention from researchers and scholars is education, particularly, female education. Education is strongly linked with better health and nutrition, improved hygiene and lower fertility rate. Educating a girl is seen as an effort that releases a multiple effect that turns around the world in a positive way. Unfortunately, a report on gender status as put together by UNESCO's EFA Global Monitoring Report (GMR) in 2015 reveals that countries within the Sub-Saharan Africa region is yet to achieve gender parity in primary as well as secondary education. At primary school level, about 16.7 million girls are out of school in SSA and gender disparities have barely changed in secondary education within the region since 1999, with an estimate of eight to ten enrolment ratios for girls and boys respectively (UNESCO's GMR, 2015). Furthermore, the report has it that a minimum of 19 countries across continents of the world possess less than 90 girls for every 100 boys enrolled in school as at 2012; 15 of which were within the SSA region.

Some of the measures put to place to ensure the girl child education is to provide free education. Some government even went further to make it compulsory for a given duration of time with penalty for defaulters. The number of years in which schooling is made mandatory across Africa greatly varies. Based on UNESCO statistics, it runs from four years (in Angola) to 11 years (in Gabon), with an average and mode of 7.4 years and six years respectively, which is consistent with primary school duration for a good number of countries (UNESCO website).

While the enforced schooling in majority of developed countries corresponds to the culmination of their secondary school (ranging from 11 to 13 years), most African countries call for at least five to seven years of primary education, with a few others enforcing the first phase of secondary education (i.e. 8 to 10 years) as mandatory.

Data over the years has shown that female education has increased significantly, and that fertility has decreased with increase in female education. The Table-1 compares the Sub-Sahara African with other regions of the world.

Table 1: Fertility rate and Female education within UNICEF region

UNICEF region		Total fertility rate and female education, 1970 – 2015					
		1970	1980	1990	2000	2010	2015
Sub-Saharan Africa	Fertility rate	6.8	6.8	6.3	5.8	5.3	4.9
	Female education	10.6	14.7	20.2	23.4	36.4	36.0
Middle East & North Africa	Fertility rate	6.7	6.2	4.9	3.2	2.9	2.8
	Female education	17.7	32.5	48.4	65.0	73.6	83.6
South Asia	Fertility rate	5.8	5.1	4.3	3.5	2.7	2.5
	Female education	13.5	17.1	26.0	36.4	56.5	58.2
East Asia & Pacific	Fertility rate	5.2	3.0	2.5	1.8	1.8	1.8
	Female education	30.3	40.4	40.2	61.4	81.3	80.3
Latin America & Caribbean	Fertility rate	5.3	4.2	3.2	2.6	2.2	2.1
	Female education	26.7	73.0	78.6	88.2	93.4	106.0
Central Europe and the Baltics	Fertility rate	2.3	2.2	1.9	1.3	1.5	1.4
	Female education	77.3	85.9	92.2	91.5	97.0	99.7
Europe & Central Asia	Fertility rate	2.6	2.2	2.0	1.6	1.7	1.8
	Female education	80.1	86.4	90.4	93.8	96.8	100.6
Least developed countries	Fertility rate	6.8	6.6	5.9	5.2	4.5	4.2
	Female education	8.4	10.3	13.4	24.6	35.8	36.4
World	Fertility rate	4.8	3.7	3.3	2.7	2.5	2.5
	Female education	35.7	44.7	47.0	57.4	69.5	76.0

Source: Compiled from WDI data 2018

The Table-1 shows regional changes in the fertility rates from one decade to another. A comparison on the rate of change in developing and least developed countries reveals that in 2015, the Sub-Saharan African region recorded a fertility rate of 4.9 as against industrialized countries within Europe and Asia with records as low as 1.4. It was also observed that fertility rate generally declined from 1970 to 2015 in all regions. Interestingly, it is clear that fertility rate has declined with the increase in female education in all the regions.

Regional Analysis of Higher Female Education and Fertility Rate within SSA

Several factors influence the extent to which female counterparts are willing to sacrifice their lifetime in acquiring knowledge. While some would just stop at secondary education, others are ready to enroll into tertiary institution to acquire more knowledge. Some factors that influence this decision include societal customs and tradition, family background, government policies among others. It was found that the level of education attained also determines the extent to which fertility is being reduced. This implies that women acquire more education (say proceed from secondary to tertiary level), the probability exists that fertility rate will reduce more.

Based on the availability of data, some countries were selected within the sub-division of the Sub-Saharan Africa countries to pinpoint this assertion. Taking the average values of fertility and level of education attained over a period of five years interval between 1981 and 2015, it is seen that countries with higher level of education among females have lower fertility rates. More specifically, Botswana records the lowest fertility rate and highest level of female enrolment

in tertiary institution between the period 1991 and 1995. Among the entire sub Saharan Africa countries, some countries within the Southern Africa region tend to have lower fertility rates compared to other countries within and outside the regions. Close to Southern Africa Region is Central Africa with relatively low fertility when compared to countries in Western and Eastern Africa. These findings from *WDI data (2018)* are presented in Tables 2 to 5.

Table 2: Selected countries in Southern Africa

Years	Fertility rate	Attained Secondary	Attained Tertiary	Fertility rate	Attained Secondary	Attained Tertiary	Fertility rate	Attained Secondary	Attained Tertiary
1981-1985	5.80	25.37	1.08	5.43	24.09	1.08	7.57	10.40	0.22
1986-1990	4.87	34.76	2.26	5.08	30.01	1.72	7.17	11.45	0.22
1991-1995	4.18	53.97	4.32	4.69	33.49	2.54	6.60	14.42	0.30
1996-2000	4.95	38.03	2.55	5.07	29.20	1.78	7.11	12.09	0.25
2001-2005	4.95	38.03	2.55	5.07	29.20	1.78	7.11	12.09	0.25
2006-2010	4.95	38.03	2.55	5.07	29.20	1.78	7.11	12.09	0.25
2011-2015	4.78	40.56	2.85	5.00	30.22	1.92	7.02	12.43	0.25

Table 3: Selected countries in East Africa

Years	Fertility rate	Attained Secondary	Attained Tertiary	Fertility rate	Attained Secondary	Attained Tertiary
1981-1985	7.44	2.16	0.27	7.10	4.39	0.33
1986-1990	7.52	3.31	0.36	7.10	7.80	0.56
1991-1995	7.38	4.71	0.45	7.05	7.68	0.89
1996-2000	7.45	3.39	0.36	7.08	6.62	0.59
2001-2005	7.45	3.39	0.36	7.08	6.62	0.59
2006-2010	7.45	3.39	0.36	7.08	6.62	0.59
2011-2015	7.45	3.64	0.38	7.08	7.07	0.64

Table 4: Selected countries in West Africa

Years	Fertility rate	Attained Secondary	Attained Tertiary	Fertility rate	Attained Secondary	Attained Tertiary	Fertility rate	Attained Secondary	Attained Tertiary
1981-1985	6.60	9.29	1.42	7.15	4.34	0.22	7.02	11.98	0.52
1986-1990	6.62	6.43	0.35	7.16	4.10	0.20	6.56	9.60	0.58
1991-1995	6.49	6.08	0.15	7.12	5.81	0.24	5.97	10.42	0.67
1996-2000	6.57	7.27	0.64	7.14	4.75	0.22	6.52	10.67	0.59
2001-2005	6.57	7.27	0.64	7.14	4.75	0.22	6.52	10.67	0.59
2006-2010	6.57	7.27	0.64	7.14	4.75	0.22	6.52	10.67	0.59
2011-2015	6.56	6.86	0.48	7.14	4.83	0.22	6.42	10.40	0.60

Table 5: Selected countries in Central Africa

Years	Central African Republic		
	Fertility rate	Attained Secondary	Attained Tertiary
1981-1985	5.95	7.60	0.19
1986-1990	5.87	6.89	0.33
1991-1995	5.69	6.14	0.40
1996-2000	5.84	6.88	0.31
2001-2005	5.84	6.88	0.31
2006-2010	5.84	6.88	0.31
2011-2015	5.82	6.73	0.33

Consistent with our theoretical dispositions are empirical studies that show that female education reduces fertility. Sharma and Ratherford (as cited in Jeffery & Basu, 1996) maintained that an increase in female literacy by 10 per cent results into a decline in total fertility rate by 0.5 n India. Also, Abadian (1996), cross country research covering about 54 developing countries, discovered that female autonomy as reflected by the age women marry, age differences between

partners and rates of secondary schooling among women significantly impact fertility negatively. Furthermore, she observed a direct effect of education on fertility rates as seen in the rates of infant mortality that reduces fertility.Simmons (1985) established a clear-cut relationship between fertility and women's education. Women participation in labour force, sex preference, adoption of family planning measures, other population programmes and policies had a moderate impact on fertility, while factors such as family preference for children, infant mortality and income level only had a toothless impact on fertility. Sandhu (1996) identified child mortality, marital considerations, social class, household structure and child bearing preference as significantly correlated with fertility in a study done in India based on multiple regression approach. The study showed that female literacy, living standard of families, together with women's standpoints on contraception are not significantly associated with fertility. Sandhu (1996) concluded from the result that the outlined variables were correlated with other variables through which fertility is being manipulated and/or no linear relationship exists between these variables and fertility. Ahmad (1991) found some socioeconomic variables to be strongly correlated with reductions in fertility rate in his review of several research works. These variables include female literacy, per capita income, labour force involvement in non-agricultural employments, infant mortality rate, women's expected lifetime, female labour force participation rate.

Theoretical Framework

This theory of fertility holds an assumption that all the determinants of fertility inclusive of health status, level of education, family planning structure, among others, work hand in hand with factors such as the demand for children (as influenced by household child preference and alternative utility, income level, and pros and cons of children), supply of children (as reflected in natural fertility factors such as subjection to and recurrence rate of intercourse, postpartum amenorrhea, unplanned intra-uterine mortality, and infertility) and fertility regulation cost.

The analytical framework provided by Davis and Blake (1956) on intermediate determinants of fertility affect the exposure to intercourse, inception of pregnancy, gestation and eventual childbirth. They identified some behavioral and biological factors through which the determinant of fertility (i.e. social, economic and environmental variables) influence fertility.

Their framework was further developed by Bongaarts (2010) who quantified the outcome of Davis and Blake's intermediate variables and collapsed them into some close determinants of fertility. The outcome of this modification is a new model that allows the analysis of changes in fertility over a time horizon and/or across different groups. In essence, Bongaarts (2010) offered a model that assists in calculating total fertility rate of any population sample with the aid of four near determinants as well as total fecundity (TF). The determinants are the index of marriage (Cm), contraception (Cc), induced abortion (Ca) and postpartum in fecundability (Ci). Hence, TFR = TF × Cm × Ci × Ca × Cc. Thus, any level of fertility in a given population is easily linked to changes in any one (or more) determinants mentioned above.

Methodology

Model Specification

Following the theoretical framework in the previous section, the relationship between the variables of interest can be expressed as TFR = f (FSSE, FLFPR, RGDPPC, HEXP). Two different models have been specified for the purpose of the analysis which is presented below

Model One

Here, an empirical static panel data model is specified as …… (1)

Where, TFR is Total Fertility Rate, FSSE is Female Secondary School Enrolment, FLFPR is Female Labour Force Participation Rate, RGDPPC is Real Gross Domestic Product Per Capita, HEXP is Total Heath Expenditure, is the error term of the model and , are the parameters. A priori expectation will be

Model Two

Here, the Generalized Method of Moments (GMM) is adopted, as established by Arellano and Bover (1995) and Blundell and Bond (1997), for dynamic panel data. This is specified as

$$Y_{i,t} - y_{i,t-1} = (\alpha\text{-}1)\, y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where *y* is the fertility rate and *x* signifies an array of explanatory variables (different from the lagged fertility rate), η represents the unobserved country-specific effect, ε connote the error term while the subscripts *i* and *t* represents the country and period respectively.

Eq (2) can also be written as

$$Y_{i,t} = \alpha y_{i,t-1} + \beta' X_{it} + \eta_i + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The model will therefore be specified as …. (5)

As with other instrumental variable estimators, for the GMM estimator to be identified, there must be at least as many instruments as there are parameters in the model. However, the instruments to be used in the estimation must not be associated with the error term (a orthogonality (moment) condition of GMM that must be satisfied). The reliability of the GMM estimator is determined by the validity of the instruments used. Hence, the Sargan/Hansen test of over-identifying restriction (J-statistic) is carried out to examine the validity of the instruments employed.

Research Methodology

For ascertaining the relationship between female literacy rate and fertility rate within the Sub-Saharan African region, the use of panel data estimation techniques will be employed. More specifically, the dataset will be analyzed by applying two different models.

Firstly, for static panel model, it will be estimated considering fixed and random effect estimators and will test which of the two empirical estimating techniques is most suitable for the study using the Hausman test. Nevertheless, both the fixed effects and random effect model will be presented for empirical robustness.

In the second model, the Generalized Method of Moments (GMM) will be looked at as it takes into account the dynamic nature of the model. Also, the J-statistics will be used as a test of over-identifying moment conditions while Arellano-Bond serial correlation test will be used to test for second order serial correlation.

Data

Twenty three (23) out of the 48 SSA countries are considered in the estimation due to lack of continuous observations for variables used in this study between the periods 1995 to 2015.

Result and Discussion

Descriptive statistics

This gives the quick summary of the data used for all the variables of interest alongside their characteristics, throughout the period of estimation under consideration.

Table 6: Descriptive Statistics of the Variables Used

	TFR	FSSE	FLFPR	RGDPPC	GHEXP
Mean	5.249449	31.56623	65.97978	292901.2	5.472157
Median	5.342000	27.37895	68.24828	72614.65	5.061302
Maximum	7.725000	111.5194	87.99301	4050429.	12.05577
Minimum	2.485000	3.111670	33.41090	567.6518	2.431666
Std. Dev.	1.249426	22.34816	14.89750	709220.7	1.852290
Skewness	-0.200529	1.223987	-0.587513	4.201524	1.049603
Kurtosis	2.490741	4.312049	2.379563	19.72393	3.996419
Jarque-Bera	8.456387	112.4965	35.53323	6991.427	102.3658
Probability	0.014579	0.000000	0.000000	0.000000	0.000000
Observations	483	350	483	479	455

Source: Authors' computation using Eviews 9

With time period of 21 years (1995-2015) from 23 countries and a total of 483 observations, the total fertility rate (TFR) is seen with an average value of 5.3274 per cent in SSA, a standard deviation of 1.304929, a minimum fertility rate of 2.48 per cent in South Africa and a maximum fertility rate of 7.716 per cent in Niger.

Also, Chad recorded the lowest female school enrolment level of 3.11 in 1995, while South Africa recorded the highest in 2014, with an average of 31.56 within the whole sub Saharan Africa region during the period of estimation. It is evident therefore from this data that lower fertility rate is induced by higher female education, as seen in South Africa. The test for normality of the variables is conducted using the Jacque-Bera test. The result shows that all the variables were not normally distributed at the five percent level of significance.

Model One: Static Panel Modeling

The test was conducted using three different estimating techniques: the pooled OLS, fixed effect and random effect estimator. The result obtained is presented in the Table 7 below:

Table 7: Panel data modeling of Fertility rate in SSA with TFR as dependent variable

Variables	Pooled OLS	Fixed effect++	Radom effect
FSSE	-0.053345 (-30.73463)*	-0.029840 (-21.29664)*	-0.031848 (-24.75149)*
FLFPR	-0.011443 (-4.639199)*	0.014089 (3.816675)*	0.011821 (3.491253)*
RGDPPC	-5.94E-08 (-1.031393)	-8.71E-07 (-4.661972)*	-3.84E-07 (-2.907576)*
HEXP	0.005334 (0.288255)*	-0.049807 (-5.926071)*	-0.048399 (-5.834069)*
No of observations	330	330	330
No of countries	23	23	23
Overall R^2	0.774291	0.985496	0.749861
F-statistics	278.7274 [0.000]*	791.8376 [0.000]*	243.5698 [0.000]*
Hausman test	n/a	n/a	25.646250 [0.0000]

** denotes 1% level of significance*

t-statistics in ( ), probability value in [ ], ++ implies most efficient and reliable result

Source: Author's compilation after computing using Eviews 9

The result of the static panel modeling shows a negative and significant relationship between fertility rate and all the explanatory variables except female labour force participation rate using both fixed and random effect modeling. In addition, the outcome of the R-square tells us that all the explanatory variables used in the model best explain 77.4 per cent, 98.5 per cent and 74.9 per cent of the systematic variations in Fertility rate using pooled OLS, fixed effect and random effect estimation technique respectively. Furthermore, values of the probabilities of the F-statistics indicate that the overall model is statistically significant.

Most importantly, the Hausman test was carried out to ascertain the best estimating technique to be used in estimation. The result of the Hausman test shows a significant chi square at 1 per cent conservative level. Hence the null hypothesis is rejected and the alternative hypothesis is accepted revealing that the fixed effect estimation technique produces the most efficient and reliable result. From the foregoing, the analysis will focus on the result of the fixed effect modeling.

Specifically, the result of the fixed effect estimator shows a negative relationship between fertility rate and female literacy rate. It further noted that a one per cent increase in female education will reduce fertility rate by 0.0299 percent. This result is consistent with the works of Ahmad (1991), Abadian (1996) and, Jeffery and Basu (1996). Furthermore, real GDP per capita is seen to have a negative relationship with fertility rate implying that as poverty level increases, they tend to give birth to fewer children because of lack of resources to carter for them. In addition, health expenditure is positively significant with fertility rate. This suggests that families

tend to give birth to fewer children in the face of a good healthcare system. The logic here is that families depend on healthcare services for good health and longevity thereby eliminating provisions for alternatives (i.e. more children) in the event of death cases.

Model Two: Dynamic Panel Modeling

The GMM is computed after applying a difference transformation method and the weighting matrix which allows for innovations with time series correlation composition which differs by cross section. The result obtained is presented in Table 8 below, however, together with fixed effect estimates to enable comparison between both models.

Table 8: Comparism of Fixed effect and GMM with TFR as dependent variable

Variables	Fixed effect	GMM
FSSE	-0.029840 (-21.29664)*	-0.001548 (-4.134150)*
FLFPR	0.014089 (3.816675)*	-0.001828 (-0.965547)
RGDPPC	-8.71E-07 (-4.661972)*	-2.25E-07 (-10.08585)*
HEXP	-0.049807 (-5.926071)*	-0.000333 (-1.013108)
TFR(-1)		0.947211 (284.2812)*
No of observations	330	297
No of countries	23	23
J-statistic	n/a	17.78299 [0.536975]

* denotes 1% level of significance, t-statistics in ( ), probability value in [ ]

Source: Author's compilation after computing using E-views 9

The result is presented together with the outcome of fixed effect estimates to enable comparison between both models. As clearly seen, result in GMM is consistent with that of fixed effect as female secondary school enrollment a proxy for literacy rate remains negative and statistically significant at 1 percent level. The value of J statistic is seen to be statistically significant as shown by the p-value which conforms to a priori expectation of non-significance. Thus, validating the instruments used in our estimation.

Test for Serial Correlation

This is examined using Arellano-Bond serial correlation test. The Arellano-Bond serial correlation test states a null hypothesis that there is no serial correlation. This is rejected if the p-vale is statistically significant at five per cent level. The result in Table 9 below shows that cannot be rejected the null hypothesis of the Arellano-Bond serial correlation test. Hence, is accepted the alternative hypothesis which indicates that there is no correlation between the variables used, thereby validating the result of our J-statistic.

Table 9: Serial correlation test result

Test order	m-Statistic	rho	SE(rho)	Prob.
AR(1)	0.014449	0.010096	0.698732	0.9885
AR(2)	0.069115	0.009669	0.139905	0.9449

Source: Computed using E-views 9

Summary and Conclusion

In this study, an attempt was made to investigate female literacy rate and fertility rate within the Sub-Saharan Africa region with the use of both static and dynamic panel data modeling on data collected from 23 SSA countries between 1995 and 2015. The results were robust to pooled OLS, fixed effect and random effect estimators for static panel modeling and Generalized Method of Moments (GMM) for dynamic panel modeling. After selecting fixed effect estimating technique using the Hausman test, the result reveals a negative relationship between fertility rate and both female literacy rate proxied by female secondary school enrollment, poverty proxied by GDP per capita, and total health expenditure. It also revealed a positive relationship between fertility rate and female labour force participation rate. Furthermore, the estimations of the dynamic panel-data results concluded that there is negative and significant relationship between fertility rate and both female literacy rate.

It is clear from this study that all the independent variables used in this work stands as factors that determine the level of fertility rate within the Sub-Saharan Africa region. More specifically, the level fertility rate significantly depends on female literacy rate, poverty level, the proportion of female active in the labour market and total health expenditures. Nonetheless, other factors exist that in one way or the other influence fertility rate. Some of which are the use of contraceptives, government regulations etc

In summary, female literacy rate drastically reduces fertility rate most especially when more women attain higher education. From the result its impact on fertility rate far exceeds the poverty level among families. Thus, careful attention must be given to the magnitude of their impact and precautionary measures taken to curtail global disaster.

Recommendations

In the light of the foregoing in the sub-section above, the following recommendations is made. The government should enforce compulsory education for female where such laws are absent and if possible increase the level of compulsion from secondary education to tertiary education.

In addition, education campaigns should be made with the aim of educating families on child bearing and family planning. This will require the allocation of more funds into the educational sector with special preference to female education. This could come in the form of free educational programs, scholarship for female student and other incentives.

References

Abadian, S. (1996). Women's Autonomy and its Impact on Fertility. *World Development*,24(2), 1793-1809.

Ahmad, A. (1991). *Women and Fertility in Bangladesh*. California: Sage Publications.

Bongaarts, J., & Casterline, J. (2014). Fertility Transition: Is Sub-Saharan Africa Different? *Population and Development Review*, *38*(1), 153–168.

Bongaart, J. (2010). The Causes of Educational Differences in Fertility in Sub-Saharan Africa. *Vienna yearbook of population research* , 8, 31-50.

Bulatao, R. A., & Ronald, L. (1983). Overview of Determinants of Fertility in Developing Countries. In Determinants of Fertility in Developing *Countries(pp.*757-787). London: Academic Press.

Davis, K., & Blake, J. (1956). Social Structure and Fertility: An Analytical Framework. *Economic Development and Cultural Change*, 4(4), 211–235.

Eloudou, P. E., Stokes, S., & Cornell, G. (2000). Are there Crisis led Fertility Decline? Evidence from Central Cameroon. *Population research and policy review*, 19(1),47-72.

Jeffery, R., & Basu, M. A. (1996). Schooling as Contraception? In *Girl's Schooling, Autonomy and Fertility Change in South Asia* (pp. 15-47). *Thousand Oaks*, C.A.: Sage Publications.

OECD. (2018). *Fertility rates (indicator).* Retrieved from https://data.oecd.org/pop/fertility-rates.htm

Simmons, G. B. (1985). Research on the Determinants of Fertility. In Ghazi Farooq and George B. Simmons (Eds.), Proceedings of *Fertility in Developing Countries: An Economic Perspective on Research and Policy Issues* (Pp. 67-108). London: Macmillan.

Sandhu, J. (1996). *Sociology of Fertility*. New Delhi: Rawat Publications.

CIA, (2017). *The World Factbook*. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2127rank.html

EFA, (2015). *UNESCO's EFA Global Monitoring Report (GMR).* Retrieved from https://en.unesco.org/gem-report/2015-efa-gender-report

Authors' Profile

Ehimhen Emmanuel is pursuing Postgraduate Studies at the University of Benin, Benin, Nigeria, where he studies Economics at the masters level. Apart from basic economic theory, his learning interests covers areas such as environmental economics, health economics and applied econometrics. He has successfully published number of research papers in the field of health economics.