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SOCIO-ECONOMIC DETERMINANTS OF FERTILITY: EMPIRICAL EVIDENCE FROM SUB-SAHARA AFRICA

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Abstract

Demographic changes are evident in the advanced countries in Europe through aging population and replacement fertility rates, while demographic transition seems to have stalled in the sub-Sahara African region because of unprecedented fertility rate. This study examined the socio-economic determinants of fertility in sub-Sahara Africa using dynamic panel estimation technique of System GMM from 1990 to 2022. Data for a cross section of 48 sub-Sahara countries were collected from the World Development Indicators database of the World Bank. The result of the SGMM estimation revealed that female population, per-capita GDP, Inflation, female labour force participation rate as well as female secondary school enrollment had negative impact on total fertility rate. On the other hand, child mortality rate, urbanization and contraceptives prevalence had positive impact and significant on total fertility rate in SSA. The study recommends among others that governments of various countries in sub-Sahara Africa (SSA) should use pragmatic measures to enhance female secondary school enrollment, completion and overall female education especially in rural areas by implementing a subsidy scheme or a free education policy to enhance female education with the objective of reducing total fertility rate in the region.

Keywords: Fertility, Inflation, Per-Capita GNP, Labour Force, and sub-Sahara Africa

JEL CODES: J13, E31, O40, J21, N37

Introduction

Since the publication of the Malthusian theory, population has attracted so much attention from economic scholars. Similarly, fertility has also attracted as much interest from economists because the dynamics of population are principally determined by fertility, therefore fertility is a direct determinants of population and an indirect determinant of economic growth as well as several human development indices. It is projected that by 2030, global population will clock 8.5 billion people. Projections also suggest that by 2050, the population of the world will be 9.7 billion, of which 50% of the population will be from sub-Sahara Africa [SSA] (Kisato, 2020). While sub-Sahara Africa still has the highest rate of fertility when compared to all other sub regions in the world, the United Nations projects that

total fertility rates may converge around the replacement rates of 2.1 by the year 2100 (World Population Prospects, 2019; as cited in Chang, et al 2022).

Two sharply contrasting trend of fertility can be observed today in the world. A set of advanced countries where replacement fertility or even below replacement fertility is obtained and a set of poorer countries of sub-Sahara Africa and other regions where demographic transition have not been completed, and fertility rates are on the average, double replacement rate. The oddity of fertility trends in SSA reflected in slow decline among other regions of the world has come to be described by some scholars as the African exception (Bongaarts & Hodgson, 2022; Kisato, 2020). While scholars in the advanced countries are interested in the factors behind the low fertility (below replacement) scholars in developing countries continue to research the factors that have kept the fertility so high for developing countries especially sub-Sahara African countries. These two extremes of fertility trends across the world are characterized on one part by the high prevalence of modernization, globalization, pursuit of education and technological progress (use of contraception, assisted reproduction) and on the other hand, by low prevalence of these social, economic and technological characteristics (Adjiwanou & Maliga, 2022). Because of the swing in different directions of the major drivers of demographic transition, the predicted convergence in fertility trends globally is quite a long way from attainment.

One of the most mentioned and poorly construed rationale for the prevailing high fertility rate in SSA is the widespread desire for large families for economic reasons, which has been the tradition before this era of widespread civilization (Bongaarts, 2020). Between 2015 and 2020, the United Nations estimated the total fertility rate of SSA at 4.7 per woman, which is double the rate obtainable in other global regions. Religious attitudes towards fertility, family structures, lack of demand for limited family size among others are reasons for the slow fertility declines of the sub-Sahara Africa region. Basically, the study examined the impact of some socio-economic determinants of fertility on total fertility rates (TFR) in sub-Sahara Africa from 1990 to 2022. The paper is structured into various sections consisting of introduction, literature review, methodology, results, conclusion and recommendations.

Literature Review

Total Fertility rates still remain very high for some sub-Saharan African countries, for instance, the 2020 TFR estimates show Niger Republic still has a total Fertility rate of 7.0, while Mali and Benin follow closely with fertility rates of 6.3 and 5.7 respectively (PRB, 2022).

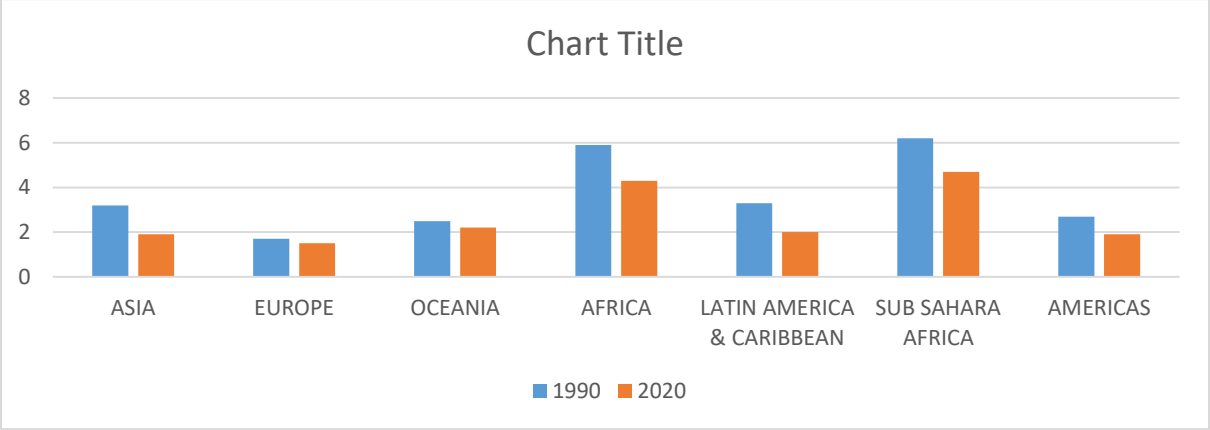

Figure 1: Multiple bar chart showing Total Fertility Rates (TFR) of various regions in 1990 and 2020.
Source: Authors' computation using Excel, 2022.

Based on the information presented in figure 1, it can be observed that Asia, Europe, and the American regions all have total fertility rates that are 2 or below by 2020. On the other hand, Oceania has a fertility rate that is slightly above the average of 2, which was obtained in all other regions. Sub-Saharan Africa on the other hand had the

highest TFR in 1990 and it still has the highest total fertility rates (TFR) in 2020 despite registering a considerable decline in TFR as can be observed graphically. The overall fertility rates of Africa are slightly lower than those of sub-Sahara Africa SSA because the northern African counties tend to have lower fertility rates compared to the countries in Southern and Central Africa (PRB, 2022).

Socio-Economic Determinants of Fertility

Demographic studies hold the opinion that theoretically, women's education was inversely related with fertility, and it is considered the most important drive of female fertility (Attari, Pervaiz & Chaudhary, 2016; Nyarko, 2021). The mechanisms through which fertility declines are achieved through women's education may include – a reduction in the number of reproductive years through delayed marriage and increased number of years of schooling. Although the years of schooling is not a reliable measure of quality of education (Bongaarts & Hodgson, 2022). Again education raises a woman's lifecycle income through earnings, and as income increases, the demand for more children decreases. Moreover, the education of women makes them more aware of healthy reproductive behaviors and the use of contraception for increasing spacing of children and to avoid unwanted pregnancies (Attari, Pervaiz & Chaudhary, 2016).

The correlation between low use of contraceptives and poor women's education is very high. In line with this assertion, United Nations Population Fund (UNFPA, 2014; as cited in Kisato, 2020) reported that sub-Sahara Africa has one of the highest prevalence of unwanted pregnancies and the lowest statistics on the use of contraception among women of reproductive age. Enhancing the access to education of women of reproductive ages and access to contraception can significantly impact the rate of unwanted pregnancies in sub-Sahara Africa. Although there has been a general increase in the adoption of contraception across the world. Remarkably, the use of contraception among reproductive women in sub-Sahara Africa has changed from a mere 13% in 1990 to 29% in 2019 (UNDESA, 2021).

A strictly negative income-fertility relationship is known to exist between per-capita incomes and fertility rates. In most cases, the very poor countries with per- capita incomes below US dollar 1,000 are almost all having fertility rates that are above five (5) children per woman. Contrastingly, the rich countries that have per-capita incomes in excess of US Dollar 20,000 almost all have fertility rates of three (3) children per woman or less (Doepke, et al, 2022). A considerably high and stable GDP per-capita income exerts a negative influence on total fertility rates (TFR) (Chang, et al, 2022).

The relationship existing between female participation in the labour force and fertility is said to be a negative one, although the magnitude of the association has been on the decrease from the 1980s. This relationship is so because of the trade-off between labor force participation and child bearing in relation to the cost of time involved. Thus, the opportunity cost of having more children is losing the chance to take up a wage paying job and vice versa. Women who have or want to have a lot of children cannot have time for career development except those who have fewer children or none (Oshio, 2019; Doepke et al, 2022).

Fertility decisions are also influenced by the cost of raising a child, which is a reflection of the general cost of living especially in urban areas. However, this may not be case for rural livelihood as the cost of living is lower and the means of livelihood, usually subsistence farming may serve as a motivation for more children. There is causal link between inflation, measured as the general cost of living and the decision to produce an additional child in an urban household (Zulqurnain & Yusuf, 2022). Small family is only ideal in urban living, thereby highlighting the important role played by urbanization in fertility decline (Lerch, 2018).

Empirical Review

A number of studies have been conducted on the socio-economic determinants of fertility although not exhaustively. Some of the notable studies on socio-economic determinants of fertility are reviewed in the studies of Bongaarts and Hodgson (2022), Arsyad, Nugroho and Nugraha (2022); Nyarko (2021), Lal et al

(2021), Bongaarts (2020) and Kisato (2020) which are more recent among others.

Bongaarts and Hodgson (2022) investigated the socio- economic determinants of fertility in a cross section of 97 developing countries from 1960 – 2015. The data used for the study were analyzed using descriptive analysis in the form of graphs as well as fixed effects estimation technique. The study found that education has a negative and significant effect for estimates of all countries, sub-Sahara Africa countries (SSA); Asia, North America and Latin America countries. Similarly, log of per-capita income and percentage of people living in urban areas also exert negative influence for all the 97 countries. Conversely, child mortality had a positive impact on fertility for all the countries and various sub regions. In another investigation using the 2017 Demographic and Health Survey data in Papua province, Arsyad, Nugroho and Nugraha (2022) investigated social, economic, demographic factors and proximate determinants of fertility in Papua provinces. The data were analyzed using descriptive statistics and multivariate regression analysis. The study found that Papua women's education had dominant impact on duration of marriage and the use of contraceptives, thus education was the dominant determinant of fertility in the Papua province of Indonesia. However, contradicting the findings of several studies on the relationship between education and fertility rate, Van Hoyweghen et al (2022) found no correlation between parents' education and fertility rates. Their study was conducted on some selected rural communities in Senegal and Uganda using primary data. They adopted the use of mixed logit model and maximum likelihood estimation techniques for the analysis of the data. They concluded that households in the study areas prefer to have more children reflecting a utility maximizing point of 7.5 children, however, women relatively prefer fewer children than men.

In another related study, conducted on a panel of six (6) selected pacific Island countries, Lal et al (2021), examined socioeconomic and demographic determinants of fertility. The study was conducted using a panel data set of six selected pacific island countries for the period 1990 -2019. Unlike the study of Bongaarts and Hodgson, the estimation techniques used in this study were Pooled OLS and random effects. The study found that female labour force participation rate, inflation rate, prevalence of contraceptives use and urbanization rate all have inverse and significant impact on fertility rate in Fiji, Somoa, Solomon Islands, Vanuatu, Tonga and PNG. In a similar study conducted in Ghana using time series data, Nyarko (2021), investigated socio-economic determinant of cumulative fertility. The study used descriptive analysis and the negative binomial regression technique for estimating the determinants of cumulative fertility. The study found that educational attendance is negatively associated with cumulative fertility, again wealth status of households also exert negative influence on cumulative fertility in Ghana. In furtherance of the investigation, Kisato (2020) also examined the determinants of fertility in sub-Saharan Africa with specific interest on the impact of education on fertility of the age group 15 -24 years. Secondary data were used in the framework of the Bongaarts proximate determinants of fertility. The study confirmed the assertion that educational attainment of women aged 15 -24 slows down fertility rates in Kenya, Ethiopia, Malawi and Mali. Also investigating the trends in fertility and fertility preferences in some selected 25 sub-Saharan Africa countries, Bongaarts (2020) arrived at a similar conclusion. The study used fixed effects regression analysis, and came to the conclusion that women's educations reduce wanted and unwanted fertility in some sub-Saharan Africa countries.

In another investigation into the determinants of fertility, Bijlsma and Wilson (2017) investigate the socio-economic determinants of fertility; using the parameter g-formula. The study used the g-formula and the generalized linear models (GLMs) for analysis. The study found that increase in higher education attendance has a significant negative suppressive impact on fertility. Moreover, using time series data and the Autoregressive Distributed lag (ARDL) as well as the granger causality estimation technique, Kengnal and Bullappa (2017) conducted an investigation into fertility and its socio-economic determinants in India for the period 1990 - 2012. The findings of the study revealed that fertility rate, urbanization, female labour force participation rate

and per-capita gross national income are co-integrated and there is a unidirectional granger causality between the four variables in the short and long-run. In a similar fashion of analysis, Audi and Ali (2016) also conducted a causality and co-integration analysis of some selected socio-economic determinants of fertility in Tunisia. The investigation was conducted over the period 1971 -2014 using time series data. The data were analyzed empirically using techniques such as the Phillip Perron (PP) unit root test, causality analysis, variance decomposition and impulse response, as well as the Autoregressive Distributed lag model (ARDL). The study found that female education and urbanization have significant negative impact on fertility rate in Tunisia, while life expectancy and per-capita income had positive and significant impact on fertility rate in Tunisia.

Also, Zulqarnain and Yusuf (2019) also conducted a study into the relationship between socio-economic factors and fertility rate in Malaysia. Deploying the Autoregressive Distributed lag (ARDL) and granger causality techniques of analysis for the period 1982 to 2019, the study found, contrary to other studies that inflation rate and female labour force participation rates had positive relationships with fertility rate in the long run. In another investigation to establish the spuriousity of the positive relationship between female employment and fertility rate in developed countries, Oshio (2019) used fixed effects regression technique to test the hypothesis. Panel data set for a cross section of 24 member countries of Organization for Economic Cooperation and Development (OECD) was used. The study found that the relationship between female labour force participation rate and fertility rate is a positive one after controlling for country-specific heterogeneity. Chang et al (2022) using a panel data set of 144 countries from 1960 to 2020 investigated global trends in total fertility rate and its relation to national wealth, life expectancy and female education. The study deployed the use of descriptive statistics, correlation analysis as well as the distributed lag non- linear (DLNM) by region for the analysis. The study found among others that in developed region, total fertility rates increased slightly with high levels of income per-capita, female expected years of schooling and human development indices (HDI).

Karakaya (2016) also investigated socio-economic determinants and fertility rate at aggregate level in Tukey. The study used provincial data in Turkey, and applied Ordinary Least Squares estimation technique. Eighty-one (81) cities or provinces as well as two hundred and ninety three (293) districts were used for the analysis. The results of the study revealed that literacy rate, female work force in non-agricultural sectors as well as population in urban areas have inverse relationship with total fertility rate in the study area. Using a similar technique of analysis as was adopted by Karakaya (2016), Attari, Pervaiz and Chaudhary (2016) also investigated the socio economic determinants of fertility in Punjab, Pakistan. The study was conducted using the Ordinary Least Squares (OLS) estimation techniques. The study found that child mortality, and employment rate had positive impact on fertility, while female literacy had a negative and significant impact on fertility rate in the districts of Punjab, Pakistan. Using a panel data set of thirty-three (33) predominantly Muslim states, Yurtseven (2015) investigated the socio-economic determinants of fertility rates from 2000 to 2013. A two-step system Generalized Method of Moments (GMM) was adopted for the estimation of the relationship among the variables modelled. The estimation results revealed that income; college enrollment rate and contraceptives uses have significant negative impact on fertility rates.

Theoretical Framework

Demographic Transition Theory

The demographic transition theory was formulated by the famous American demographer Warren Thompson in 1929. The demographic transition theory explains using four different epochs, the different patterns of demographics that constitute change (decrease) in fertility rates and mortality rates due to changes in human conditions and scientific/technological advancements. The theory illustrated that in the first epoch, fertility rates and mortality rates were both high. It also made prognostications that in the last epoch, fertility rates will fall drastically due to fall in mortality rates and rise in life expectancies. However, between the fist and the last epochs, various socio-economic

transformations are attributed to the declines in birth rates and death rates of the two extreme eras. Some of these changes include scientific advancements, urbanization, socialization, globalization, widespread education, technological advancement (Caldwell et al, 2006).

The first epoch of the theory was characterized by poor scientific and technological know-how and therefore socio-economic retardation. It was a pre-industrial society that had high death rates and corresponding high birth rates to create an artificial balance. Infant and child mortality rates were high, and deaths from diseases that are curable today were high in that epoch. Population rates and food production rates were also low in that epoch. The second epoch as demonstrated by the theory was characterized by increase in scientific and technological know-how. There was increase in medical advancement reducing the death rates and increasing life expectancies. Cures have been found for the common diseases that claimed a lot of lives in the first epoch and vaccinations were developed for the diseases that were claiming a lot of lives, thus applying the brakes on death rates, but without a significant corresponding decrease in birth rates, as in some places, the decline in death rates were not too obvious (Galor, 2011, Kirk, 1996).

In the third epoch, demographic transition which is reflected in significant declines in death and birth rates are obvious. In this epoch, urbanization, prevalence of contraception, widespread education and further advances in medical sciences further reduce death rates and drive birth rates downward. The declines in birth rates are more evident in the developed countries than in the developing countries in this epoch (Thompson, 1929).

In the final epoch, there are declines in birth rates and death rates to a level of replacement. Replacement level of fertility is reflected by the birth rates of 2 -3 children per woman. The population of several advanced countries in this stage falls drastically and migration to these set of countries from the regions where fertilities are still relatively high like sub-Sahara Africa and Asia becomes commonplace. The population is characterized by aging and high life expectancies. However, the same cannot be said of the developing countries of Africa, North America and Asia, as the transition from high birth rates to low birth rates are low in the regions or even stalled as scholars suggest in the cases of sub-Sahara Africa (Sachs, 2008; Bongaarts, 2020).

Methodology

Region and Countries

Sub-Sahara Africa is the name given to the African region that is geographically below the North African region. Sub-Sahara Africa is ecologically separated from the North African countries by the largest and sparsely populated desert in the world, - Sahara Desert (ABC-CLIO, 2017). Four major sub-regions form the sub-Sahara African region, namely; East Africa, West Africa, Southern Africa and Central Africa. The East African countries include; Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, South Sudan, Sudan, Tanzania, and Uganda. The West African countries include; Benin, Burkina Faso, Cape Verde, Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mauritania, Mali, Niger, Nigeria, Senegal, Sierra-Leone and Togo. The Central African countries include; Central African Republic, Cameroon, Congo republic, DR Congo, Chad, equatorial Guinea, Gabon, Angola, and Sao Tome and Principe. The Southern African countries include; South Africa, Namibia, Botswana, Lesotho, Zambia, Zimbabwe, Swaziland, Malawi and Mozambique.

Sub-Sahara Africa plays host to the 10 poorest countries in the world, thereby qualifying the region to be seen as the poorest region in the world (Ventura, 2022). There are about 49 countries in sub-Sahara Africa, however, for the purpose of this study, 48 countries were used, with the exception of South Sudan because of poor data coverage. The average total fertility of the region was estimated by the United Nations at 4.7 births per woman between the period 2015 -2020 (Bongaarts, 2020).

Data and Sources

An unbalanced panel data set of 48 sub-Saharan Africa countries were sampled and used for the study. The data were sourced from the World Development Indicators

database of the World Bank (World Bank, 2022). Data were collected for GDP per-capita (currents US dollar), total fertility rates (TFR), urbanization rate (URB), female population (FPOP), child mortality (CHM - number of under 5 deaths), female labour force participation rates (FLFP), inflation rates (INF - consumer price index), prevalence of contraceptives (CTP), and female secondary school enrollment (SCE), over the range of period 1990 to 2022.

Model Specification

The model used to examine the relationship between fertility rate and the set of independent variable modelled in this study is expressed as;

$$TFR_{it} = \beta_0 + TFR_{it-1} + \beta_1 LOGFPOP_{it} + \beta_2 LOGURB_{it} + \beta_3 CHM_{it} + \beta_4 LOGFLFP_{it} + \beta_5 INF_{it} + \beta_6 LOGPCG_{it} + \beta_7 CTP_{it} + \beta_8 LOGSSE_{it} + \mu_{it} \quad (1)$$

Where;

TFR - Total fertility rate (births per woman)
FPOP - Total Female population
CHM - Child mortality (total under 5 deaths)
FLFP - Female labour force participation rate
INF - Inflation rate (consumer price index)
PCG - Per- Capita GDP
CTP - Contraceptives prevalence (any method; percentage of women 15 -49 years)
SCE - Female Secondary school enrollment
μ_i - Disturbance term
i - Cross-sectional dimension of the panel data
t - Time dimension of the panel data

Method of Analysis

We adopted the use of the dynamic panel data estimation techniques developed by Blundell and Bond (1998). The system GMM estimator which incorporates the level and difference equations was used because of its superiority over the Arellano and Bond (1991) Difference GMM estimator, in that it produces more efficient and precise, less bias estimates. The underlying tests of hypothesis that follow the system GMM estimation were also conduction to test the erogeneity of instruments (Sargan test) and Autocorrelation to test whether the residuals ae correlated (Law, 2018). Descriptive statistics as well as correlation analysis were also employed as additional tests.

Results and Discussion

Table 1: Summary of Descriptive Statistics

Variables	Observations	Mean	Std. Dev.	Minimum	Maximum
TFR	1482	5.17	1.336195	1.36	7.806
FPOP	1536	8350856	1.31E+07	34750	1.06E+08
URB	1536	5888500	1.10E+07	34246	1.13E+08
CHM	1488	109.328	55.15154	13.7	341.2
FLFP	1504	58.52529	17.62813	14.215	90.555
INF	1328	110.3846	926.2634	-11.68611	23773
PCG	1459	564861.7	1317715	6.22E-07	1.16E+07
CTP	317	26.46372	17.13139	1.7	75.9000
SCE	773	37.03776	26.7255	2.40476	117.8821

Source: Analysis using STATA 17, 2023.

The total fertility rate (TFR) of sub- Sahara Africa have been unprecedented with a mean value of 5.17 between 1990 and 2021. The minimum TFR recorded in SSA over the period of study was 1.36, obtained in Mauritius, in 2015. A maximum of 7.80 was obtained in Niger Republic in 1990. Child mortality (CHM) which is one the most influential determinant of high fertility in the past has also remained high with a mean of 109.328. The minimum child mortality recorded was 13.7, which was recorded in Seychelles in from 2001 -2005. A maximum prevalence of child mortality of 341.4 was recorded in Niger Republic in 1992. This may partly explain the high fertility trends of Niger Republic, as child mortality was highest in the country among other SSA countries.

Female labour force participation (FLFP) was generally low in SSA with a mean value of 58.52 and a

minimum value of 14.215, which was recorded in Djibouti in 1991, while a maximum of (90.555) was recorded in Burundi in 1990. Contrastingly, Burundi also has high fertility rate, of which, theoretically, the high participation of female in the labour market should have driven down over the study period. Although the prevalence of contraceptives is one of the variables for which records are poorly documented, is very low in SSA with a mean value of 26.46 and a minimum of 1.7, recorded in Guinea in 1992. Interestingly, Guinea has an average fertility of 6.1 in the 1990s, which correlates with the low contraceptives prevalence. A maximum contraception rate of 75.90 was recorded in Mauritius in 2002, a country with average fertility rate of 1.9 at the turn of the century. Female secondary school enrollment rate has been very low in SSA with a mean of 37.03 and a minimum value of 2.404, which was obtained in Chad in 1990, a country with TFR of 7.2 in the same year. The maximum secondary school enrollment rate for female was 117.88, which was recorded Sychelles in 1994, a time when the country had a corresponding TFR of 2.6, suggesting a correlation between education and fertility rate.

Table 2: Correlation Matrix

	TFR	FPOP	URB	CHM	FLFP	INF	PCG	CTP	SCE
TFR	1.00								
FPOP	0.146	1.00							
URB	0.053	0.954	1.00						
CHM	0.707	0.089	0.043	1.00					
FLFP	0.277	0.047	-0.044	0.190	1.00				
INF	0.017	0.102	0.085	0.078	0.228	1.00			
PCG	0.062	0.041	0.081	-0.180	0.001	-0.186	1.00		
CTP	-0.770	-0.141	-0.106	-0.607	0.070	-0.012	-0.078	1.00	
SCE	-0.826	0.043	0.160	-0.698	-0.209	-0.041	-0.061	0.727	1.00

Source: Analysis using STATA 17, 2023.

The correlation between child mortality rate (CHM) and total fertility rate (TFR) is strongly positive (0.70) suggesting that as child mortalities increase, fertility rates also increase. The association between contraceptives prevalence (CTP) and fertility rate (TFR) is strongly negative (-0.77), suggesting that increased contraceptives use reduce fertility rates. Similarly, female secondary school enrollment has a strongly negative relationship (-0.82) with fertility. This may suggests that as female secondary school enrollment increases, it drives fertility rates downward.

Urbanization rate (URB) and Female population (FPOP) shared a very strong positive correlation (0.95). Female secondary school enrolment (SCE) and child mortality (CHM) shared a strong negative association (-0.69), again, contraceptives prevalence (CTP) also shared a strong negative association with child mortality (CHM) depicted by -0.60. Contraceptives prevalence (CTP) also has a strongly positive correlation (0.72) with female secondary school enrollment.

Table 3: Summary of System GMM Results

Variables	One step System GMM	Two step System GMM
TFR_{t-1}	1.032595	1.032595***
LFPOP	-0.0728469	-0.0696986***
LURB	0.0798636	0.077445***
CHM	0.0003705	0.0004962
LFLFP	-0.0403824	-0.0475705***

INF	-0.0005452	-0.000551***
LPCG	-0.0196494*	-0.0200875***
CTP	0.0023493*	0.0022043***
LSCE	-0.0072445	-0.0022043
Sargan test	35.40151(0.8928)	25.45433(0.995)
p-value		
AR (1)		-0.79858
p-value		(0.4245)
AR (2)		-1.0321
p-value		(0.0.0307)
N	48	48
T	31	31

Source: Analysis using STATA 12, 2023.

Note: The variables are defined as follows: TFR = Total Fertility Rate; LFPOP = log of Female Population; LURB = log of Urbanization rate; CHM = Child Mortality Rate; LFLFP = Log of Female Labour Force Participation rate; INF = Inflation Rate; LPCG = Log of Per Capita GDP; CTP = Contraceptives Prevalence; LSCE = Log of Female Secondary School Enrollment. Significance; ***, ** and * indicate significance at 1%, 5% and 10% respectively.

Conventionally, the GMM technique can be estimated at one step, two step and two step with robust standard errors. The post estimation test of validity of instruments (Sargan test) and the autocorrelation test are indicative of the most efficient result to adopt. Thus in line with the post estimation results obtained, the two step SGMM results are more efficient and thus interpreted accordingly.

The log of Female Populations (FPOP) has a coefficient of -0.0696986 which is suggestive of the fact that a negative and significant association exists between female population and fertility rate in SSA. The coefficients suggests that total fertility rate will decrease by 0.0696986 as female population increases by 1 unit. This relationship suggests that as female population increases by 1 unit the prospective number of children each woman will likely conceive, tends to decrease unconsciously.

The coefficient of urbanization rate (URB) is 0.077445 which suggests a positive and significant impact of urbanization rate on total fertility rate. Although this association contravenes the theoretical expectations, it numerically implies that total fertility rate in SSA will increase by 0.077445 percentage points each time urbanization rates increases by 1 percent. This finding is not consistent with the findings of Bongaarts and Hodgson (2022) and Lal et al (2021) who found urbanization to affect fertility rate negatively. In the same vein, child mortality rate (CHM) was found to have a positive and significant impact on total fertility rate which is consistent with a priori expectations. The coefficient being 0.0004962 suggests that total fertility rate in SSA will increase by 0.0004962 units each time child mortality rate increases by 1 unit.

As expected, female participation in labour force exerted negative and significant impact on total fertility rate in SSA, thus total fertility rate will decrease by 0.040382 percentage points when female labour force participation rate increases by 1 percent. This finding is consistent with the finding of Oshio (2019) and Zulquarnain and Yusuf (2019) who also found female labour force participation rate to have a positive impact on fertility rate. Also consistent with theoretical expectations is the fact that Inflation rate (INF) was also found to exert a negative and significant impact on total fertility rate. Total fertility rate will decrease by 0.000551 units if inflation increases by 1 unit. This result is consistent with the finding of Lal et al (2021) who found that inflation had a negative relationship with fertility rate. On the other hand, it contravenes the finding of Zulquarnain and Yusuf (2019) who found inflation to impact positively on fertility rate.

Per-capita GDP also impacted negatively and significantly on total fertility rate in SSA. The statistic of

(PCG) suggests that total fertility rate will decrease by 0.0200875 percentage points if per-capita GDP increase by 1 percent. This finding is inconsistent with the findings of Bongaarts and Hodgson (2022) who found that Per-capita income had negative impact on fertility rate but consistent with the findings of Chang et al (2022) whose study found positive association between Per- Capita Income/human development index and fertility rate.

Also female secondary school enrollment (SCE) exerted a negative but insignificant impact on total fertility ate in SSA. The coefficient of the variable implies that total fertility rate will decrease by 0.0002843 percentage points. This result is consistent with the findings of Bongaarts and Hodgson (2022); Arsyad, Nugroho and Nugraha (2022); Nyarko (2021); Kisato (2020) and Bongaarts (2020). On the other hand, the finding of this study is inconsistent with the finding of Van Hoyweghen (2022) who found no correlation between parents' education and fertility. Chang et al (2022) also found a positive impact between years of schooling and fertility, which is inconsistent with the finding of this study.

Also contrary to expectation is the fact that contraceptives prevalence (CTP) was found to have a positive impact on fertility. Contraceptives prevalence was found to exert a positive and significant impact on total fertility of SSA, the coefficient suggests that total fertility rate will increase by 0.0022043 units when contraception increases by 1 unit although the oddity of the relationship can be attributed to the small number of observations -317 (see descriptive statistics table) data on contraception in the sub region, because correlation result showed an inverse relationship between the variables. This finding contradicts the finding of Lal et al (2021) who found that contraceptive use has a negative impact on fertility.

Conclusion and Recommendations

The unprecedented total fertility rate of the sub-Sahara African region may have resulted from a complex interaction of cultural, religious and socioeconomic factors. Because of the complexity and dynamism of the factors, fertility rates in the sub-region might take another decade or two to experience significant decline.

The empirical results obtained from this study show that the positive determinants of fertility in SSA are urbanization rate and child mortality rate, which also share positive correlations with total fertility rate. On the other hand, the negative determinants of fertility in SSA are female population, inflation rate, female labour force participation, per- capita GDP and female secondary school enrollment which measures overall female education. The following recommendations are proffered;

(i) Governments of various countries in sub-Sahara Africa (SSA) should use pragmatic measures to enhance female secondary school enrollment, completion and overall female education especially in rural areas by implementing a subsidy scheme or a free education policy to enhance female education with the objective of reducing total fertility rate in the region.

(ii) Governments of SSA countries should make legislations that will incorporate some form of affirmative action for women to enhance their participation in the labour market which will inversely affect fertility rates of the region.

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