The Effect of Education on Fertility Rates in Sub-Saharan Countries

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Abstract

Past research finds that education and fertility rate have a negative causal relationship. The more year of education generally tends to have a lower number of fertility rates. In sub-Saharan countries high fertility rate leads to other issues in the population dynamics, in terms of the economy and health. The study investigates the relationship between education and fertility rate looking at literacy rate as the main explanatory variable. The panel data set looks at Sub-Saharan countries from 1990-2019 acquired from the World Bank. There are other control variables and demographics that are observed in the model. A 2-way fixed effect model is conducted looking at the unit(countries) and time in years which to analyze the variables. The main literacy variable did not have the expected coefficient and was not statistically significant. Other variables infant mortality had significance and had a positive coefficient and suggests that this is to have persistence in reproductive success. Generally, the results obtained seemed to have no statistical significance with the variable that was explored. We can possibly explain this because the lack of consistent data in Sub-Saharan countries.

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Introduction

The fertility rate, globally, has dropped to under two and half children per woman, which is a major decline in the fertility rate in the last 50 years. The global fertility rate has decreased from 2.1% per year in 1968 to 1.1% in 2020(United Nations, 2020). However, in Sub Saharan African countries total fertility rates are as high as 4.7% which is almost double the level of any region globally (World Bank). African countries have seen a reduction in fertility in the past 50 years but are still experienced soaring fertility rates. According to UNESCO (2018), 60% of youth (between 15-17 years of age) in Sub-Saharan African countries are not enrolled in any educational programs which could possibly explain the higher-than-average Total Fertility Rate. Global improvements in education and training, labor participation, and women rights are factors that could possibly explain the reduction in fertility rate. In developing Sub-Saharan countries, fertility stands at high numbers in relation to global levels. Contrary to that, education and woman empowerment are at low levels. Economic development and the status of the women contribute heavily to how many children a woman will bear during her lifetime. This paper will explore the relationship between education and fertility rate using data from World Bank from 1990 to 2019. From Previous research shows that there is a relationship between education and income levels. There are other possible factors that can affect fertility rate and can be used as control variables for the regression.

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Literature Review

The relationship between education and fertility has been explored and evaluated by several researchers. Research has been conducted at micro and macro levels in a variety of regions. Osili and Long (2007) analyze the causal effect of female schooling on fertility, focusing on the introduction of universal primary education (UPE) in Nigeria. The research focused on introduction of UPE, which is an educational project. Using a dataset acquired from the 1999 Nigerian Demographic Health Survey (NDSH) they employ a difference-in-differences methodology, relying on the geographic variation in implementation of UPE to determine the impact of this program on fertility. To account for overage enrollment in UPE, the authors rely on the 15-20 years old females as the control group. The authors specifically focus on the intensity of the UPE, defined by the enrollment rate, to compare the high and low intensity states to each other. They find that educated women in high intensity states had fewer births than women in the control group. They concluded that UPE program was a suitable factor for schooling, showing an additional year of schooling cuts the number of children born by 26%.

The paper by Monstad, Karin, et al. (2008) explains the negative causal relationship between declining fertility rate in and women's education level. Education tends to provide a better understanding on contraceptives as well as possibly educational activity being conflicting with the investment in childcare. This is the possible negative relationship between years of schooling and fertility rate in women. The authors consider three variables for fertility outcome: timing of children, number of children and childlessness. They concluded that there is a strong statistical relationship between the time of education and fertility. In other words, women that go to school longer have a higher likelihood to have less or no children. Hence justifying the initial hypothesis of more years of school means less children given birth to.

A paper by Alexis Leon in 2004 shows the effect of education on fertility using compulsory schooling laws. From this research, they explain relationship between schooling and fertility, the paper estimates the effect of education and the impact it has on fertility. The impact of education is measured through policy implications, in terms of fiscal and welfare reforms. The study was on women in the United States ranging of age between 40-49, reaching or past their fertility period. The regression results show there is a negative causal relationship between education and fertility, which is explained by the compulsory schooling laws that have been placed over the years.

From these papers we can infer that fertility rates go down as education increases. All papers have a similar principal hypothesis and there resulting data and results support them.

Theoretical Discussion

There are several possibilities and mechanisms that explain how education influences childbirth. The economic idea of opportunity cost is one possible explanation. Female education lowers the level of fertility due to the increase in opportunity cost of childbearing for women (Barro and Becker,1988). More years of education may lead to better understanding of the costs of childbearing and therefore lower pregnancy rate. Education could possibly reduce fertility by increasing knowledge about contraceptives as well as awareness about sexual health. Given various channels through which more education can lead to lower fertility rate, the main hypothesis of this paper is that an increase in literacy rate and primary school enrollment in sub-Saharan countries should have a significant effect on decreasing the fertility rate in these countries.

Another possible theory that can explain the model proposed is the Ideation theory. The ideation theory shows more educated women can learn information of desired family size

through school, community, and exposure to global communication networks (World Bank). Education is not only defined by schooling but also other involvements and exposure which is explained in this theory.

Data and Empirical methodology

For this research, datasets that are being analyzed are from the World Bank Database. The data is from 46 sub-Saharan countries from 1990 to 2019. We will use the fertility rate of female population in Sub Saharan countries as the dependent variable. There are several explanatory variables that are explored to explain women's fertility rate, listed, and described in **Table 1** in the exhibition section.

Equation (1) displays a simple regression model that explains the variation in fertility rate and is used as the basis for the fixed-effects model of this paper:

$$Fertilityrate = \beta_0 + \beta_1 Education + \beta_2 Infantmortality_{it} + \beta_3 Contraceptive_{it} + \beta_4 Governmentexpenditure_{it} + \beta_5 GDPperCapita_{it} + \beta_6 FemaleLFPR_{it} \quad (1)$$

To investigate this research question, a panel dataset was acquired from 46 countries in Sub-Saharan African countries from 1990 to 2019. The dependent variable in the study is Fertility rate, with female education (literacy rate or primary school enrollment, depending on the model) being the main explanatory variable of interest. This study controls for other factors that can affect childbearing outcomes, namely demographic variables as well as income (GDP per capita), government expenditure per capita, contraceptive use, and infant mortality rate. The latter variable is included in the model to account for the fact that with lower death rate among children, women may need to have less pregnancies to achieve the desired family size.

The above model does not control for a variety of variables that are constant over time for a country or they are the same for all countries in any given year. The absence of such control variables may introduce omitted variable bias. To account for these variables, the above model can be expanded to be a two-way fixed-effects model. The fixed-effects model represented in the following general model.

$$Fertilityrate = \beta_1 E_{it} + \beta_2 D_{it} + \beta_3 C_i + \beta_3 Y_t + \in \quad (2)$$

The *E* variable represents the education variables, which are namely Female Primary School Education and Literacy Rate. *D* represents all control variables listed in the previous equation which are variable across countries and over time. Variables *C* and *Y* represent country and year fixed effects, respectively. I borrow the methodologies from Osili and Long (2007) and look at how education level affects fertility rates in Sub-Saharan Africa using a different education variable.

Empirical Results

As it was discussed in the data section, the data for this project include a panel of 46 countries in sub-sub-Saharan Africa from 1990 to 2019. There were 2 models that were compared, one is the OLS and the other is a two-way fixed effects model. The results of the 2 models are displayed in Table 4 in the appendix. To understand the relationship between fertility rate and education, an OLS regression is run. There were 398 observations in the model. The OLS model had an R-Squared value of 0.2676 and an F-value of 15.72. Hence, the OLS model explains approximately 27% of variation in the fertility rate. On the other hand, the fixed-effects model explains about 88% of the variation in this variable.

In both models, the literacy rate has a positive impact on the fertility rate which is the opposite of the expected sign according to the theoretical framework of this paper. According to the OLS model, 1 percentage points increase in literacy rate increases fertility rate by 0.003 percentage points, but it is statistically insignificant. The effect size increases to 4 percentage points in the fixed-effects model, and it becomes statistically significant. Primary School enrollment had 95% significance and contained the sign not expected from the theoretical framework, In the fixed-effect model 1 percent increase in primary school enrollment increases Fertility Rate by 0.005 percentage points. The created variable of *Govtexprevenue* showed an expected sign in the fixed-effect and OLS model and had no statistical significance. With this variable, there is varying populations within the cross-country analysis hence this is to scale the monetary variables across all the countries. Total government revenue is negative relationship with fertility rate, increase in government revenue decreases fertility rate however no statistical significance.

Conclusion

The main idea of the paper is to show the evidence of education on fertility sub-Saharan countries. There are other factors that have a significant effect on the fertility rate. Through the OLS regression and fixed effect model there was an expected negative causal relationship between education and fertility. Generally, the main variable of education did not have the expected sign and the statistical significance, which opposes our theory. Infant mortality is significant with a positive coefficient which can be explained by losing a child can influence a woman to try more to reach reproductive success hence increasing the fertility rate. From the results obtained, there are other control and demographic variables that have significance, LFPR shows a positive relationship with fertility rate and is statistically significant. This can be

explained by more income a woman earns, encourages the childbearing responsibility that she will face.

With the current results, there is an unexpected coefficient values and signs. However, this can be explained due to some limitations that could have caused this error. One possible limitation is the very periodic and not consistent over the years in countries in Sub-Saharan Africa. The missing data for almost all variables and all countries made it difficult to make a precise analysis on the issue. From earlier literature, we expected a negative relationship between fertility in women and education. The results obtained in both models did not correspond with the proposed theoretical framework that was set out. Hence to have more precise and accurate results, the recording of consistent data over the years.

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Exhibits

Table 1: List and explanation of variables			
Full variable name	Variable code	Definition	Source
Literacy rate	Literacy	Ability to have basic reading and writing skills, (% of people aged 15 and above)	World Bank
Fertility Rate	Fertrate	Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years	World Bank
Infant Mortality Rate	Infantmortality	Females that make up workforce (% of total population ages 15-64)	World Bank
Labor Force Participation rate	LFPR	The number of infant deaths for every 1,000 live births	World Bank
Primary school enrollment	Primarysch	Primary School Enrollment (%gross)	World Bank
Contraceptive use	Contracept	Any method of knowledge acquired about contraceptive (% of women ages 15-49)	World Bank
Government Expenditure on Education	Govtexp	Percentage of Government expenditure on Education from all other sectors	Word Bank
GDP per capita	GDPpercapita	GDP per capita is gross domestic product divided by midyear population.	Word Bank
Total Government Revenue	Totalrev	Revenue, excluding grants (% of GDP)	Word Bank
Government Expenditure on Education per country	Govtexprev	Government Expenditure on Education * Total revenue	Word Bank

Table 2: Descriptive Statistics

Varibale	N	Mean	Std Dev	Min	Max
Literacy	396	57.8	27.91	22.2	92.05
Fertrate	396	4.26	1.85	1.43	7.77
Infantmortality	396	55.03	24.56	12.7	161.7
LFPR	396	59.88	15.57	23.45	90.77
Primarysch	396	82.59	45.42	75.68	147.71
Contracept	396	38.27	15.62	15.6	63.8
Govtexp	396	5.26	2.31	3.25	10.09
GDPpercapita	396	1889.27	2314.64	371.27	10153.94
Totalrev	396	19.23	5.86	12.07	50.79
Govtexprev	396	69.41	303.53	0	2065.09

Table 3: OLS and fixed effect model regression results

Variables	OLS	FIXED EFFECT
Intercept	2.84*** (0.49)	**NOINT**
Literacy	0.00307 (0.306)	0.00272 (0.00282)
Mortality	0.02522 *** (0.00408)	0.4362 *** (0.00259)
LFPR	0.00256 (0.00578)	0.01882 *** (0.00341)
PrimarySchool	0.000881 ** (0.00188)	0.00476 ** (0.00148)
Contracept	0.00756 ** (0.00538)	0.01079 * (0.00511)
Govtexp	0.061 (0.0402)	0.010719 ** (0.03667)
GDPper capita	-0.0000192** (0.0000059)	0.00002717 (0.0000282)
Totalrev	-0.01082 (0.0083)	-0.00730 (0.0071)
Govtexprevenue	0.019 (0.00828)	0.0000806 (0.00014893)
N	398	398
R-Sq	0.2676	0.8793
F-Value	15.72	762.28

T-values in the parenthesis. *, **,*** are the significance level for 10%,5% & 1% respectively.

Appendix

Table 4: Pearson Correlation Coefficients, N=398 Prob>|r| under H0: Rho= 0

	Literacy	Mortality	LFPR	Primarysch	Contracept	Govtexp	GDPpercapita	Totalrev	Govtexprevenue
Literacy	1	-0.20723	-0.04127	0.06162	0.12358	0.12277	0.25627	0.16219	0.23922
		<.0001	0.4128	0.2211	0.0139	0.0145	<.0001	0.0012	<.0001
	398	396	396	396	396	396	396	396	398
Mortality	-0.20723	1	0.16312	-0.07122	-0.1008	-0.14736	-0.51823	-0.42211	-0.33161
	<.0001		0.0011	0.1572	0.045	0.0033	<.0001	<.0001	<.0001
	396	396	396	396	396	396	396	396	396
LFPR	-0.04127	0.16312	1	0.1653	0.07231	0.0494	-0.34295	0.03795	-0.28141
	0.4128	0.0011		0.001	0.1509	0.3268	<.0001	0.4514	<.0001
	396	396	396	396	396	396	396	396	396
Primarysch	0.06162	-0.07122	0.1653	1	0.02556	0.18668	-0.14905	-0.01301	0.01922
	0.2211	0.1572	0.001		0.612	0.0002	0.0029	0.7964	0.703
	396	396	396	396	396	396	396	396	396
Contracept	0.12358	-0.1008	0.07231	0.02556	1	0.1804	-0.02751	0.13135	0.03454
	0.0139	0.045	0.1509	0.612		0.0003	0.5851	0.0089	0.4931
	396	396	396	396	396	396	396	396	396
Govtexp	0.12277	-0.14736	0.0494	0.18668	0.1804	1	-0.01527	0.07598	0.31976
	0.0145	0.0033	0.3268	0.0002	0.0003		0.7619	0.1312	<.0001
	396	396	396	396	396	396	396	396	396
GDPpercapita	0.25627	-0.51823	-0.34295	-0.14905	-0.02751	-0.01527	1	0.47143	0.60152
	<.0001	<.0001	<.0001	0.0029	0.5851	0.7619		<.0001	<.0001
	396	396	396	396	396	396	396	396	396
Totalrev	0.16219	-0.42211	0.03795	-0.01301	0.13135	0.07598	0.47143	1	0.17148
	0.0012	<.0001	0.4514	0.7964	0.0089	0.1312	<.0001		0.0006
	396	396	396	396	396	396	396	396	396
Govtexprevenue	0.23922	-0.33161	-0.28141	0.01922	0.03454	0.31976	0.60152	0.17148	1
	<.0001	<.0001	<.0001	0.703	0.4931	<.0001	<.0001	0.0006	
	398	396	396	396	396	396	396	396	443

SAS code

```
libname Leul "C:\Users\lan42\Downloads";
Data Leul.fert;
proc import out= Leul.fert
datafile= "C:\Users\lan42\Downloads\educfert.csv"
DBMS=csv replace;
run;

Proc sort;
by  Country_code year;
run;


data Leul.Fert;


if Literacy = 0 then delete;
if Mortality= 0 then delete;
if LFPR=  0 then delete;
if PrimarySch= 0 then delete;
if Contracept= 0 then delete;
if Govtexp=  0 then delete;
if GDPpercapita= 0 then delete;
if Totalrev=  0 then delete;
if Govtexpenrevenue= 0 then delete;
run;

Data Leul.fert;
if Country_code = 'AGO' then delete;
if country_code = 'GNQ' then delete;
if country_code = 'ERI' then delete;
if country_code = 'ETH' then delete;
if country_code = 'GIN' then delete;
if country_code = 'GNB' then delete;
if country_code = 'LBR' then delete;
if country_code = 'NGA' then delete;
if country_code = 'STP' then delete;
if country_code = 'SYC' then delete;
if country_code = 'SOM' then delete;
if country_code = 'SSD' then delete;
run;

proc means
Data=Leul.fert;
```

```
var Literacy Fertrate Mortality LFPR primarysch Contracept Govtexp GDPpercapita Totalrev
Govtexprevenue;
run;
proc corr data= work.Leul;
var Literacy  Mortality LFPR primarysch Contracept Govtexp GDPpercapita Totalrev
Govtexprevenue;
run;

proc reg;
model Fertrate= Literacy  Mortality LFPR primarysch Contracept Govtexp GDPpercapita
Totalrev Govtexprevenue;
run;

proc sort data= Leul.fert;
by country_code year;
run;
proc reg;
model Fertrate= Literacy  Mortality LFPR primarysch Contracept Govtexp GDPpercapita
Totalrev Govtexprevenue/NOINT;
run;

proc panel data =Leul.fert;
id country_code year;
run;

proc corr data= work.Leul;
var Literacy Fertrate Mortality LFPR primarysch Contracept Govtexp GDPpercapita Totalrev
Govtexprevenue;
run;
```