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EFFECT OF EDUCATION LEVEL ON FERTILITY IN SUB-SAHARAN AFRICA: PANEL COINTEGRATION ANALYSIS

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ABSTRACT

The aim of this study is to investigate the impact of education level on fertility rate. In this frame, impact of primary, secondary and tertiary school enrollment of female is questioned for Sub-Saharan African countries by panel data cointegration analysis. In the scope of this study, 13 Sub-Sahara countries 'data are contributed to the analysis for the period of 1990 to 2011. As to the results positive relationship is found between the primary school enrollment of female and fertility rate. On the other hand negative relationship is found between both secondary school enrollment and fertility rate and tertiary school enrollment of female and fertility rate.

Keywords: Fertility; school enrollment of female; panel cointegration.

1. INTRODUCTION

Because of the number, and the timing of births determine the future potential human resources, determiner of the fertility rate began to be one of the major topics in economic analysis. Analysis which was performed by the help of the scientific branch as demography, it was determined that the education is the most important factors for the fertility rate. [1] [2] [3] [4].

Previous studies can be described as questioning whether the change in education level of women affects the fertility rates. This study aims to fill in this gap with the panel data analysis of the relationship between the changes for the education level of women and the fertility rate. In this study, 13 Sub Africa countries data' were contributed to the analysis for the period of 1990 to 2011.

The reason for including the Sub-Sahara is that this region which has the highest fertility rate, being an under developed country. Hence, it is expected that the effects of independent variables to affect the fertility rate can be more distinct. Besides, the results to be obtained can helpful for under developed countries on predicting the problems in related processes, and making policies.

In the analysis panel cointegration tests which was developed by Pedroni [5] and Kao [6] was performed and FMOLS estimator was used. The results indicate that, primary school enrollment has positive effect on fertility rate and direction of relationship is negative by the increasing level of education. The secondary school enrollment and the tertiary school enrollment decrease the fertility rate.

In this study firstly we describe the interaction mechanism of education and fertility. Section II summarizes related literature which about the effect of women's education level on fertility. Section III presents the empirical model and describes the data sets. Section III also provides descriptive statistics both from the data sets and from outside sources on economic and demographic indicators for the

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thirteen Sub-Sahara Africa countries under study. Section IV describes the results dealing with the effect of education level on fertility. Section V reviews the results and proposes areas for additional research.

2. INTERACTION MECHANISM OF EDUCATION AND FERTILITY

Interaction between education and fertility rate is being through four main channels (Ainsworth at. al.,1996,86) These are;

• Wage effects.

The Wage Effect upon the fertility level realizes by some ways. The first of them and the mostly known one is the opportunity cost. In full-certainty model of fertility to Montgomery and Trussell[7] children are considered as a normal good and their care requires time and money considered as shadow price of children [8] These are component functions of the wage rate. In the event that a person gains money by working, he or she has to give up child care. Under this circumstance, the opportunity cost of childbearing is the money which was earned by working. If the income increases, the opportunity cost will scale up as well [9] [10]. Secondly, the person whose income increased, also wants to increase her income level more, and then tries to increase education level. And if a person doesn't have any children, will put off having children, and the aging decreased the fertility rate of the person. If the person had a child before, she or he would lose his or her motivation for having one child more. The reason behind the statement that the increasing level of education decreases the number of children can be those previous explanations [8].

One of the way of effect upon fertility by income is increasing income facilities of a woman's own decision making for her own life. The role of the woman in a family increasing with better income and they join the decision making more. In the transition period from the urban to the rural life, one of the reasons behind the decreasing fertility rate can be this mentioned statement.

•Higher demand for child schooling.

One of the reasons behind the increasing level of the family decreases the fertility level is the increasing consciousness of families about life and their desire for having a better life for their child in future. The educated parent presents better facilities for their children which they didn't have before, so they try to sustain a better future for their children. The main efforts among them are the education in a good way. On the other hand, the higher level of expenditures on education forces the families to use the available resources for one child by having less children. The parents are forced to choose one alternative between the number of children they want to have, and the quality of education for children. This is the quantity-quality tradeoff observed in other parts of the world [11] [12].

•Health Sanitation and Lower child mortality.

In the studies which presents the idea that there is a negative relation between the fertility level and urbanization, it is emphasized that the issue occurs due to the changes in the facilities of health services, adding up the change on the role of woman in a society. The healthy environment in which people live decreases the level of infant mortality and presents a platform for the number which families aims to reach as an ideal through less child birth. In a cross-national study, Schultz [13] found that fully half of the effect of female schooling in lowering fertility was operating through its effect in lowering child mortality.

• More effective use of contraception.

The effective usage of contraceptive can be seen one of the determinants behind that the increase of education level has a negative impact on fertility. The increasing effective usage of contraceptive, owing to education, decreases the unwanted child bearing. Giving up the traditional methods makes ones more efficient on having children whenever they want, for any number they wish.

There are some debates about the effect of the education on fertility. Some researchers suggested that female schooling raise fertility indirectly by improving maternal health, reducing pathological sterility, and reducing the duration of breastfeeding and its contraceptive benefits [14], [15], [16], [17],[18],[19],[20]. On the other hand, some of them suggested that educated women use contraception more effectively and, reducing the number of unanticipated pregnancies. So fertility rate can be decreased with education. Table 1 presents the related literature about effect of education on fertility.

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Table.1: Related Literature About Effect Of Education On Fertility

Author	Method	Countries	Finding and Results
Shapiro (2012) [4]	Regression analysis	28 Sub-Saharan Countries	Places where women's education is greater tend to be places where fertility is lower.
Bongaarts (2010) [3]	Cross sectional	30 Sub-Saharan African countries	Education levels are negatively associated with fertility and desired family size.
Becker et al. (2010) [21]	Panel data analysis	330 country-level observations in Prussia	The trade-off between fertility and education, two way causation between fertility and education.
Upadhyay and Karasek (2010) [22]	Regression analysis	4 Sub-Saharan Africa countries	With education empowered women were more likely than less empowered women to have more children than they desired.
Bongaarts (2008) [23]	Cross sectional analysis	29 countries	Poorly performing economies, rising mortality family planning (education) are plausible factors contributing to the stalling of fertility.
Cruces and Galiani [24]	Two-Stages Least Squares	Argentina, Mexico	Female education levels are much lower fertility rate will to be higher.
Leon [8]	Two-Stages Least Squares	Western Countries	Rising levels of education can account for a sizable fraction of the decline in fertility rates.
Kravdal (2002) [25]	Discrete-time hazard regression	22 Sub-Saharan Africa	Average educational level in a community has a significant depressing effect on a woman's birth rates.
Rutstein [2]	Comparative analysis	43 different countries	A curvilinear relationship exists in about half of the sub-Saharan countries where fertility is higher for women who has primary education than who has either no education or secondary or higher education.
Ainsworth, Beegle, and Nyamete (1996) [26]	Regression analysis	14 Sub-Saharan African countries	Female primary schooling have a negative relation with fertility in about half the countries, while secondary schooling is associated with substantially lower fertility in all countries.
Martin (1995) [27]	Logit regression analysis	26 least-developed countries,	In some of the least-developed countries, education might have a positive impact on fertility.
Martin and Suarez (1995) [28]	Regression analysis	9 Latin American countries	Schooling on reproductive behavior and partly explain the wide fertility gap
Jejeebhooy (1995) [1]	Cross sect. analysis	59 different studies	Women's education tends to reduce fertility.
Schultz (1994) [14]	Panel data analysis	68 countries	Increasing the schooling of women is the best predictor for reducing fertility.
Schultz (1993) [13]	OLS	47 countries	Better health and education of children lead to a slower growth in population
Cleland and Rodriguez paper (1988) [17]	Regression analysis	22 countries	Fertility will fall with each increment in education.

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United Nations (1987) [29]	Survey	26 countries	Lower fertility rates are invariably found among women with higher levels of education.
Cochrane (1986) [18]	Regression analysis	28 developing Latin America and Asia countries	Education is uniformly inversely related to fertility.

3. DATA AND EMPIRICAL METHODOLOGY

3.1 Data

The multivariate panel framework includes fertility, primary school enrollment, secondary school enrollment and tertiary school enrollment. All the variables are expressed in natural logarithms. The unbalanced panel data is collected for the period from 1990 to 2011 for 13 Sub-Saharan African Countries and obtained from World Bank [30] . The definitions and sources of data are presented in Table 2.

Table 2: Data Definitions and Sources

Code	Name	Source
FERT	Fertility Rate (Births per woman)	WDI[a]
PSCHE	Female Primary School Enrollment (% gross)	WDI[a]
SSCHE	Female Secondary School Enrollment (% gross)	WDI[a]
TSCHE	Female Tertiary School Enrollment (% gross)	WDI[a]

[a]The World Bank World Development Indicators: http://databank.worldbank.org/data/views/variable Selection/selectvariables.aspx?source=world-development-indicators

3.2 Model

In order to capture the impact of education on fertility, consider the regression model:

$$LFERT_{i,t} = \alpha_i + \beta_1 LPSCHE_{i,t} + \beta_2 LSSCHE_{i,t} + \beta_3 LTSCHE_{i,t} + \varepsilon_{i,}$$

Where t refers to the time period, $LFERT_{it,}$is the births of per woman, $LPSCHE_{it}$ female primary school enrollment percentage of gross $LSSCHE_{it}$female secondary school enrollment and $LTSCHE_{it}$ female tertiary school enrollment.

In this specification, the impact of the primary school enrollment on export is expected to be positive since low level education facilitates to find low-income job. When education level is higher people are employed with higher income. So opportunity cost of child bearing is increasing. Because of the higher opportunity cost of childbearing it is expected that decreasing in fertility rate. For this reason expected coefficient of LSSCHE (B_2) and LTSCHE (B_3)negative.

3.3 Econometric methodology

In this study panel data method was preferred. The panel data methods are more powerful compared to the time series unit root and cointegration approaches, by combining information from both time and cross-section dimensions. To analyze the effect of education level on fertility we utilize the panel cointegration Test developed by Pedroni[31] and Kao [6] that allows heterogeneous cointegration relation across countries.

3.3.1. PedroniPointegration Test

Pedroni [5] extends his residual-based panel cointegration tests [5] for the models, where there are more than one independent variable. He maintains several residual-based null of no cointegration panel cointegration test statistics. Pedroni developed seven cointegration statistics to test for the null of no-cointegration among the variables. The four statistics – within-dimension panel cointegrationtests pool the autoregressive coefficients (ϕ_i) across different members for the unit root tests on the residuals. The next three statistics – between-dimension panel cointegration tests take the average of the individually estimated coefficients for each cross-section in the panel [32]

In Pedronicointegration test, firstly equation (1) is estimated for each country by using the ordinary least squares (OLS). Then, the following auxiliary regression on the residuals is estimated by the OLS.

$$\varepsilon_{it} = \phi_i \varepsilon_{it-1} + v_{it}$$

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The null hypothesis of no cointegration H_0:$\phi_{i=1}$for all i is tested against the alternative of H_1: $\phi_i = \phi_i < 1$for all "i" in the within-dimension approach and of H1: $\phi_i < 1$ for all i in the between-dimension approach. So, an additional source of potential heterogeneity across cross-sections can be adequately captured by the between-dimension approach. The panel cointegration statistics which have the asymptotic standard normal distribution are derived as follows Pedroni [5] :

Within-dimension panel cointegration statistics:

Panel v - stat: $Z_v = T^2 N^{\frac{3}{2}} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1}$

Panel rho - stat: $Z_\rho = T\sqrt{N} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i)$

Panel pp-stat: $Z_t = \left(\hat{\sigma}_{N,T}^2 \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i)$

Panel adf-stat:$Z_t^* = \left(\tilde{S}_{N,T}^{*2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11}^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*} \Delta \hat{e}^{*}{}_{i,t}$

Between-dimension panel cointegration statistics:

Group rho-stat:$\tilde{Z}_\rho^* = TN^{-1/2} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{t=1}^{T} \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i$

Group pp-stat: $\tilde{Z}_t = N^{-1/2} \sum_{i=1}^{N} \left(\hat{\sigma}_i^2 \sum_{t=1}^{T} \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{t=1}^{T} \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i$

Group adf-stat:$\tilde{Z}_t^* = N^{-1/2} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \tilde{s}_i^{*2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}_{i,t-1}^{*} \Delta \hat{e}_{i,t}^{*} \right)$

To determine the long run relation cointegration vector is estimated. The cointegration parameters are obtained by the panel fully modified ordinary least squares (FMOLS) developed by Pedroni [33]. The panel FMOLS estimator is derived from the following equation:

$$y_{it} = \alpha_{i+} \beta x_{it} + \mu_{it}$$

Where $y_{it}$is the dependent variable and x_{it}($x_{it}=x_{it-1}+u_{it}$) is the vector of regressor. The panel FMOLS estimator is given by:

$$\hat{\beta}_{GFM}^* = N^{-1} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} (x_{it} - \bar{x}_i)^2 \right)^{-1} \left(\sum_{t=1}^{T} (x_{it} - \bar{x}_i)\, y_{it}^* - T\hat{\gamma}_i \right)$$

Where $y_{it}^* = (y_{it} - \bar{y}_i) - \frac{\Omega_{21,i}}{\Omega_{22,i}} \Delta x_{it,} \hat{\Omega}_i$is the long-run covariance matrix which is estimated using the Newey–West heteroscedasticity consistent estimator. The t-statistic associated with the cointegration parameters is obtained by$t_{\hat{\beta}^*_{GFM}} = N^{-1/2} \sum_{i=1}^{N} t_{\hat{B}^*_{F,M,i}}$, where

$$t_{\hat{\beta}^*_{GFM}} = \left(\hat{B}_{F,M,i} - B_0 \right) \left((\hat{\Omega}_{11i}^{-1} \sum_{i=1}^{T} (x_{it} - \bar{x}_i)^2 \right)^{1/2}$$

3.3.2. Unit Root and Cointegration

In the study we had to use unbalanced data set. This is the main constraint for choosing unit root and cointegration test. The second generation panel unit root and cointegration tests take into account cross sectional dependency; however, they require balanced panel data sets [34]. So in order to examine the relationships among the variables in concern, the first generation panel unit root and cointegration methods are applied to the data set. In the analysis, to ensure robustness for the common components of Fertility rate

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(LFERT), primary school enrollment (LPSCHE), Secondary school enrollment (LSSCHE) Tertiary school enrollment (LTSCHE), Im, Peseran and Shin unit root test is employed. Im, Peseran and Shin [35] unit root test results are presented in Table 3. According to the test results, we have found that LFERT,LPSCHE, LSSCHEandLTSCHEseries are stationary in first differences.

Table 3.Im, Peseran and Shin Unit Root Test Results

Series	W Statistics (Probabilities)		
	Level	First Difference	Results
LFERT	-0.92416 (0.177)	-2.88847 (0.001)	I(1)
LPSCHE	0.47521 (0.682)	-6.34899 (0.000)	I(1)
LSSCHE	-0.21324 (0.415)	-3.38467 (0.000)	I(1)
LTSCHE	-0.12355 (0.450)	-24.2074 (0.000)	I(1)

Notes:a)Newey-West bandwidth selection using Bartlett kernel. b) Individualintercept and trend effects
c) Automatic lag length selection based on SIC: 0 to 4

In the unit root test lag length is chosen automatically and Schwarz information criteria ~~are~~ is used. Having verified that the series are non-stationary and same order integration as I(1), it is tested whether there exist any long run equilibrium relationship between the variables using Pedroni and Kao Panel Cointegration test. Results are presented in Table 4 and Table 5.

Table 4.Pedroni Panel Cointegration Test Results

Within Dimension Test Statistics		Between Dimension Test Statistics	
Panel v-statistics	8.540(0,000)	Group rho-statistics	3.553(0.999)
Panel rho-statistics	2.735(0.996)	Group PP-statistics	-5.988(0.000)*
Panel PP-statistics	-2.805(0.025)	Group ADF-statistics	-5.796(0.000)*
Panel ADF-statistics	-4.099(0.000)		

Notes: The 1%, 5%, and 10% critical values are respectively 1.28, 1.645, and 2.33 for the panel-v statistic, and - 1.28, -1.645, and -2.33 for other statistics. Probability values are in parenthesis.

We have seen from the Pedroni Panel Cointegration test, except panel rho and group rho- statistics, five out of seven statistics reject the null hypothesis of no cointegration 1% significance level. That is, there is a long run relationship between the variables.

Table 5: Kao Panel CointegrationTest Results

	t-Statistic	Prob.
ADF	1.517	0.064

1- Automatic lag length selection based on SIC with a max lag of 1
2- Newey-West automatic bandwidth selection and Bartlett kernel

As well, according to Kao panel cointegration test results there is a long run cointegration between variables.
In the next step, the fully modified OLS (FMOLS) technique for heterogeneous cointegrated panels is estimated [33] and four different models are estimated. Table 6 shows this FMOLS results.

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Table 6. Panel FMOLS Estimation

LFERT =	0.146 LPSE*** - 0.192 LSSE*** - 0.074 LTSE***		
t-statistics	(2.673)	(-3.861)	(-3.473)

Note: *** p<0.01, ** p<0.05, * p<0.1 Standard errors are in parentheses.

According to the results, primary school enrollment effect on fertility rate positive and statistically significant, but secondary school enrollment and tertiary school enrollment have negative impact on fertility. 1% increase in the primary school enrollment leads to 0.146% increase on fertility. On the other hand 1% increase in the secondary school enrollment leads to 0.192% decreases and 1% increase in the tertiary school enrollment leads to 0.074% decrease on fertility rate.

4. CONCLUSION

In this study in which the effects of education level upon fertility level was questioned, and it is stated that the effects of education level on fertility show differentiation. Especially, the increase of primary schooling increases the fertility rate. Owing to the primary schooling, the women becoming conscious on hygiene, the improving health services and the protection from the illnesses which can prevent pregnancy of a possible future could be efficient. The existence of a threshold relating with the income can be thought here. Thanks to the increase of the education level, this threshold can be overcome and the opportunity cost of child birth can increase by the increasing income. In the event that the women after primary education continue to the secondary education and tertiary education, the age of marriage can increase and this lateness results in less giving birth to earth. Besides, owing to the increase of education level, the living environment of woman changes and the immigration towards the urban areas begins.

Suggestions for further studies

According to the analysis done, the effect of the primary schooling for fertility level in a positive manner can be questioned for reasons. If the increase of the primary schooling via increasing the income level affects the fertility level in a positive manner to a certain degree then continues to affect in a negative manner, the existence of a threshold could be questioned. This mentioned threshold can be differentiable among the countries. Nowadays, the incentive policies to increase the fertility rates are suggested for the countries who want to be rejuvenated and enlarged in a demographic manner. Knowing the answer of the question that which income level should be given the incentives will sustain the efficient usage of the public funding.

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