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« Axe 1: Transition démographique, inégalité du genre et croissance économique »

« THE IMPACT OF GENDER INEQUALITY IN EDUCATION ON INCOME PER CAPITA IN THE ECONOMIC COMMUNITY OF WEST AFRICAN STATES»

WP

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ABSTRACT

This paper aims to analyse the effect of gender inequality in education on per capita income in the Economic Community of West African States (ECOWAS). We consider the gender parity index in secondary school enrolment and secondary school enrolment gross rate (% female) to assess gender inequality in education. The results show that the reduction of gender inequality in education leads to an increase in income per capita in ECOWAS in the short run as well as in the long run. The long-run effect is greater than the short-run effect. Improving education system remains an engine for better life in underdeveloped areas.

KEYWORDS

Gender inequality, education, income per capita

CODE JEL

I24 ; O11

1 | Introduction

The analysis of gender inequalities in Africa generally refers to the following aspects: education, labour market participation, mortality, income, access to factors of production, respect for rights. Among all these factors, it must be recognized that Africa has made efforts to reduce inequalities in the field of education (Klasen, 2017; World Bank, 2011). The number of girls and women with basic education is higher than ever, and more girls than boys are enrolled in developing countries. Eliminating gender disparity is a key and long-held goal of the international development community. The United Nations Millennium Development Goals include the elimination of gender disparity in primary and secondary enrolments by 2005, and at all levels of education by 2015 (United Nations, 2000).

In the West African region, the relatively good economic performance of the past two decades has not addressed inequalities of any kind. Inequality has reached significant levels in the region, so the per capita income gap between the richest (minority) and the least wealthy (largely) grows over the years (Hallum & Obeng, 2019). According to this study, whether in terms of per capita incomes, education, access to the labour market, access to health, representation of women in decision-making bodies, inequalities are also glaring. The Economic Community of West African States (ECOWAS) Commission has understood the need to integrate gender in its strategy of strengthening integration. It has set up an institutional framework for the promotion of gender equality. This recognition is reflected in Article 63 of the Revised ECOWAS Treaty that calls on "Member States to formulate, harmonize, coordinate and implement the appropriate policies and mechanisms to improve the economic, social and cultural conditions of women. The ECOWAS Gender Development Centre (EGDC) is an ECOWAS specialized agency on gender and development set up during the 26th Session of the ECOWAS Authority of Heads of State and Government, held in Dakar in 2003 by Decision A/DEC.16/01.03. ECOWAS considers gender equality as an engine of regional integration and a full-fledged development objective. In collaboration with its partners, EGDC advocates for the effective implementation of existing commitments and mechanisms to ensure gender equality in the ECOWAS region.

Gender equality in education remains a concern for policymakers in this region not only because this equality in education is a basic human right, but also because it represents

an important source of creating sustainable economic growth, employment and productivity. What are the effects of gender inequality in education on income per capita in ECOWAS? In this paper, we are interested in gender inequalities in education because we believe that all other forms of gender inequality seem to depend heavily on this. To better defend one's rights, to position oneself on the labour market, to better control one's fertility, to improve one's living conditions to reduce the death rate are indicators that could be improved with a better education. Promoting gender with improved access to women's education would help to improve women's living conditions. Subsequently, women who are better able to contribute to the creation of wealth would lead to the better economic performance of the countries as well as to the improvement of the living conditions of the population. The paper explores the impact of gender inequality in education on income per capita in ECOWAS. Specifically, it will present a state and the evolution of gender inequality in education in ECOWAS. It is organized in 3 sections. The first section presents a literature review on the relationship between gender inequality in education and per capita income. The second describes the methodology and the third one shows and discusses the main finding before concluding.

2 | Literature review

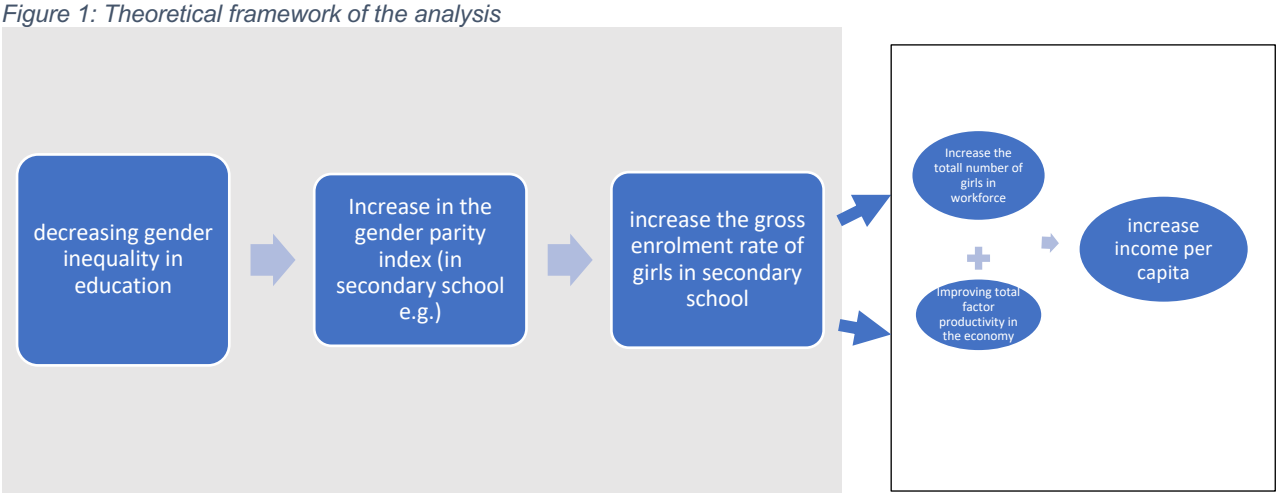
2.1 | Gender inequality in education and economic growth: a theoretical framework

The theoretical framework for the analysis is endogenous growth. Endogenous growth theories seek to show that growth is a self-sustaining phenomenon enabled by the accumulation of physical capital, technology, public capital and human capital. The accumulation of these factors is characterized by growth in yields and positive external effects that catalyse economic growth. This study is part of the theoretical framework of endogenous growth with an emphasis on the effects of human capital. Human capital was highlighted by Schultz and Becker. Human capital is at the centre of Lucas' work (1988). Human capital refers to the individual's total capacity that increases its productive effectiveness. According to this theory, everyone owns a certain number of skills, which he values in the labour market. In this context, the individual, to increase his skills invests

in his training and education. Thus, an economy will grow more if it invests more in training and education. Moreover, economic performance will be all the better as the economy, as a company, is in a skilled labour environment sufficient to drive an increase in the overall productivity of primary factors in general and more specifically the productivity of the labour factor.

The reduction of gender inequalities in education in this analysis will be directed in the direction of increasing the gross enrolment rate of girls compared to that of boys at secondary levels. The choice of secondary level is justified by the fact that according to the literature review, this level provides the individual with at least the necessary skills to produce wealth in the economy. Thus, an increase in the number of girls in education generated by investments in the enlistment system will lead to an increase in the potential labour force and the overall productivity of the labour factor in general and of girls in particular, thus the labour factor in the economy. Therefore, the increase in potential employment combined with the improvement in productivity explained by training, not only lead to an increase in output and overall income. At a given population level, this process leads to an improvement in income per capita. This increase in per capita income will lead to new investments in the education sector, which in turn will help to reduce the disparity between girls and boys in education.

Figure 1: Theoretical framework of the analysis



Source: The author

The presentation of this theoretical framework highlights a (reciprocal) causal relationship between gender inequalities in education and per capita income. But this analysis will only

focus on the one-way relationship presented in figure 1. The reduction of gender inequalities in education in this analysis will be geared towards the direction of increasing the gross enrolment rate of girls compared to that of boys in secondary levels: a relative indicator and an absolute indicator. The choice of secondary school is justified by the fact that in the education and training system in most ECOWAS countries, this level provides the individual with minimum skills to produce wealth. Referring also to the minimum age to be in the labour force, i.e. a minimum of 15 years, which is an age of at least one individual at the secondary level. Thus, as shown in figure 1, any increase in the number of girls in education caused by investments in the enlistment system will lead to an increase in the overall productivity of girls, and thus of the labour factor in the economy. This increase in productivity can be explained by the increase in the number of girls in the training system. Access to education and training will make these girls more productive in the production system. This increase in overall productivity will lead to an increase in aggregate production and thus in overall income and therefore in per capita income at a given population level. This increase in the per capita income will lead to new investments in the education sector, which in turn will help to reduce the disparity between girls and boys in education.

2.2 | Relationship between gender inequality in education and economic growth: an empirical review

Gender inequality has an impact on economic growth. Several econometric studies have attempted to estimate the (negative) impact of gender inequalities on economic growth and to estimate the growth gains that greater equality could generate. According to a study by Klasen and Lamanna (2009), gender inequalities between sub-Saharan Africa and East Asia account for 0.46% of the 3.48% average difference in the growth rate of GDP per capita between the two groups of countries between 1960 and 2000. The same study also confirms the existence of two kinds of negative effects of gender inequalities, the one directly related to the lower productivity of women's indirect through the influence of inequalities on population growth and investment. These two kinds of effects are mutually reinforcing to account for a sizeable share of sub-Saharan Africa's economic growth deficit relative to East Asia.

Some authors have shown that the relationship between gender inequality and per capita GDP growth depends on the level of development of the countries considered (Amin, Veselin, & Martin, 2015). For the relatively developed countries, inequalities seem to increase with the increase in GDP per capita. While in developing countries, these gender inequalities constrain economic performance and development.

Amin, Veselin, & Martin, (2015) used data from 107 countries to investigate the relationship between gender inequality and growth. Their study differs from the previous ones on two levels. On the one hand, it is based on the United Nations gender inequality index, which considers health, employment and political empowerment. Thus, the three authors use a measure of gender inequality that goes well beyond gender inequalities in education, unlike most studies. On the other hand, they examine the heterogeneity that is likely to be the relationship between gender inequalities and growth, particularly according to the level of income of the country. Thus, they seek to determine whether gender inequalities and economic developments are substitutes or complement for growth.

Their findings confirm that greater gender inequality is strongly associated with lower per capita income growth. However, this negative relationship between gender inequality and growth can be explained by data from poor countries, with data for rich countries not showing such a relationship: at sufficiently high-income levels, there is no relationship statistically significant and robust between gender inequalities and economic growth. As developing countries are characterized by low standards of living and high gender inequalities, they can both reduce gender inequalities and stimulate their economic growth by implementing policies to address gender inequalities issues.

Gender inequality is a ubiquitous feature in many developing countries. The gaps between the results and the opportunities of men and women are present in several dimensions: education, income, occupation, access to formal employment, access to managerial positions, access to productive inputs, political representation or bargaining power. in the household, (Cuberes & Teignier, 2011). There is a growing literature on the impact of gender inequality on income per capita, its growth and related variables. Among the many studies are Hill and King (1995), Klasen (1999, 2002), Knowles et al. (2002) and Abu-Ghaida and Klasen (2004), Duflo(2012) and Bandiera and Natraj (2013). Klasen (2002),

for example, shows that gender inequality in education has direct and indirect effects on income growth.

Inspired by Solow's growth model, disaggregating the human capital factor by gender (male-owned and male-owned human capital), Knowles, Paula, & Dorian, (2002) estimate the impact of gender disparities. accumulation on the steady-state income level. They show that there is a negative relationship between the achievement gap between women and men and income. Empirical analyses of the impact of gender inequalities on economic development have first and foremost highlighted inequalities in education. Indeed, several studies have shown that progress in women's education boosts their wages. Besides, returns to education are often higher for women than for men (Schultz, 2002; Andrew, Dhushyanth, & Nistha, 2007).

Also, progress in women's education would contribute to human development, including reducing child mortality and improving overall health and education in society. Since human development promotes economic growth, this suggests that the reduction of gender inequalities in education favours the latter. Several empirical studies have shown the existence of a negative relationship between gender inequalities in education and standard of living. From data for the 1975-1985 period, Hill & Elizabeth, (1995) find that there is a statistically and economically significant negative correlation between the achievement gap in primary and secondary education and per capita GDP. It is concluded that gender inequality in education hurts rural poverty. The empirical findings suggest that female-male enrolment ratio, female-male literacy ratio, female-male ratio of total years of schooling, female-male ratio of earners and education of household head have a significant negative impact on rural poverty (Chaudhry & Saeedur, 2009).

Licumba, Dzator, & Zhang,(2015) examine the impact of gender equality in education on economic growth on a panel data of five Southern African countries between 1970 and 2010. The evidence presented in this analysis suggests that there is a positive, robust and significant effect of gender equality in education on economic growth in the region. Their result advocates policy adjustment in education planning to ensure retention of girl students as well as raising education quality, to stimulate economic growth and advance other valuable development goals. Klasen, (1999) then used a larger growth interval assuming that human capital is only profitable in the long run. It uses, on the one hand,

the ratio relating the number of years of schooling of women to that of men and, on the other hand, the rate of growth of this ratio over time. He then notes that these two measures are positively correlated with economic growth.

Dollar & Roberta, (1999) reassess the impact of women's success in secondary school on growth, but by controlling success rates in high school for men. Unlike Barro & Jong-Wha, (1994) and Barro & Sala-I-Martin, (1995), they find that women's success in secondary education (in this case, a larger share of women in the adult population who have a high school diploma) is associated with a higher rate of growth, but only in countries where women are already highly educated. As we can learn from these studies, gender inequality in education or elsewhere hurts income and it seems like there is a negative relationship between gender inequality in education hurts living condition indicators. So, indicators of living conditions are deteriorating with an increase in inequalities in education.

Ultimately, the literature shows that gender inequalities influence countries' economic performance. Gender inequality in education is one of the major channels of gender inequalities impacts on economic growth. This literature points out thus an unsystematic relationship between economic growth and gender inequality in education. This link between gender inequality in education and economic growth is sometimes positive or negative. It is positive and this reflects the fact that more gender inequality in education further promotes economic growth. The negative relationship shows rather; that this gender inequality is a shortfall for wealth creation. What is the impact of gender inequalities in education on income per capita in ECOWAS?

3 | Methodology and data

3.1 | Empirical model specification

We consider a Cobb Douglas production function:

$$Y_{it} = A_{it}\ L_{it}^{\alpha}\ K_{it}^{\beta} \qquad \textit{Equation 1}$$

with Y_{it}, L_{it}, K_{it} et A_{it} respectively the overall product of the economy, the level of the labour force, the stock of capital and all external factors. Subsequently, A_{it} is supposed to depend on the parity index in education IPE_{it}as follows:

$$A_{it} = {Z_{it}}^{\theta}\, A_0\, IPE_{it}^{\gamma} \qquad \textit{Equation 2}$$

with Z_{it} a set of control variables and A_0 is a constant. In this expression, it is assumed that reducing gender inequalities in education (or increasing IPE_{it}) is a source of productivity gains and positive externalities that lead to an increase in output and therefore per capita income (for a given level of population). The production function becomes:

$$Y_{it} = ({Z_{it}}^{\theta}\, A_0\, IPE_{it}^{\gamma})\; L_{it}^{\alpha}\; K_{it}^{\beta} \qquad \textit{Equation 3}$$

By taking the product per capita, the equation becomes:

$$\frac{Y_{it}}{L_{it}} = ({Z_{it}}^{\theta}\, A_0\, IPE_{it}^{\gamma})\; L_{it}^{\alpha-1}\; K_{it}^{\beta} \qquad \textit{Equation 4}$$

Finally, the per capita income relationship is written, noting $\tilde{Y}_{it}$ per capita income, is written:

$$\tilde{Y}_{it} = ({Z_{it}}^{\theta}\, A_0\, IPE_{it}^{\gamma})\; L_{it}^{\alpha-1}\; K_{it}^{\beta} \qquad \textit{Equation 5}$$

Taking the linear form of the previous expression in which $x_{it} = ln\,(X_{it})$, we have :

$$\tilde{y}_{it} = a_0 + \theta\, z_{it} + \gamma\, ipe_{it} + (\alpha - 1)\, l_{it} + \beta\, k_{it} \qquad \textit{Equation 6}$$

Under the theoretical framework presented in section (2.1), the theoretical specification can be written as follows:

$$\tilde{y}_{it} = a_0 + a_1\, \tilde{y}_{it-1} + \theta\, z_{it} + \gamma\, ipe_{it} + (\alpha - 1) l_{it} + \beta\, k_{it} + \varrho_{it}$$

Equation 7

The analysis will also be done with the secondary education enrolment indicator: the gross secondary school enrolment rate for the girls' population; because to achieve parity, thus reducing inequality in education, it is necessary to improve the gross enrolment rate of girls.

The effects of reducing gender inequalities in education are leading to an increase in enrolment. Knowing that the effects of investments in education are observed over time, we apply the time series econometric approach applied to panel data.

3.2 | Data and variable definition

3.2.1 | Data

The data cover the 1971 to 2017 period. The missing data for other countries were imputed by the average over the period for each variable. The database is a panel of 13 member countries of the Economic Community of West African States including

Mauritania except for Liberia and Sierra Leone (both countries were omitted due to many missing data).

Table 1: Data description

Variables	Sources
GDP per capita (current US$)	World Bank, World Development indicators
Gross fixed capital formation (% of GDP)	
Population ages 15-64 (% of the total population)	
Gender parity index (GPI) in School enrolment, secondary	
Gross enrolment rate for girls in secondary school (% gross)	
Inflation, GDP deflator (annual %)	

Source: the author

3.2.2 | Variable definition

The ***Gender parity index*** for gross enrolment ratio in secondary education (GPI) is the ratio of girls to boys enrolled at secondary level in public and private schools. This indicator is calculated by dividing the gross enrolment rate of women in secondary education by the gross enrolment rate of men in secondary education. The Gender Parity Index (GPI) indicates gender parity. An GPI of less than 1 suggests that girls are more disadvantaged than boys in learning opportunities and an GPI of more than 1 suggests the opposite. Eliminating gender disparities in education would help to increase women's status and abilities.

The ***Gross enrolment rate for girls*** is calculated by dividing total number of girls enrolled in secondary school by total number of girls belonging to the age group officially enrolled in secondary school and multiplying by 100. Both variables Gender parity index and Gross enrolment rate for girls, are expected to have a positive effect on income per capita according to the theoretical framework described in subsection 2.1.

4 | Mains findings

4.1 | Gender inequality and income per capita in ECOWAS: what do we know from data?

Table 2 presents descriptive statistics of the variables. Between 1971 and 2017, GDP per capita on the overall ECOWAS sample is 652.72 US $.

Table 2: Descriptive statistics

Variables	Mean	Std. Dev.	Relative standard deviation	
			Overall	Between
GDP per capita (current US$)	652.72	603.71	92%	64%
Gross capital formation (% of GDP)	22.65	11.57	51%	35%
Inflation, GDP deflator (annual %)	10.46	18.46	177%	85%
Population ages 15-64 (% of total)	52.14	2.50	5%	3%
School enrollment, secondary (gross), gender parity index (GPI)	0.6	0.22	37%	33%
School enrollment, secondary, female (% gross)	20.5	19.25	94%	81%

Source: World development indicators, the author

This value shows that, on average, the countries in the sample are low-income countries according to the World Bank classification. The new thresholds (compared to GNI per capita in current USD, Atlas method) are shown below (Box 1).

Box 1: New classification of countries according to the income level : 2020-2021

Groupe	1st of July 2020	1st of July 2019
Low income	< 1036	<1026
Intermediate income/lower bound	1 036 - 4 045	1 026 - 3 995
Intermediate income/upper bound	4 046 - 12 535	3 996 - 12 375
High income	> 12 535	> 12 375

Source : https://blogs.worldbank.org/fr/

The value of relative standard deviation of *the GDP per capita (current US$)* shows a high heterogeneity across the sample because the standard deviation is just over 92% of the average (See table 2). This heterogeneity is relatively lower between countries because the standard deviation is 64% of the average per capita income in the sample. There is a strong heterogeneity among countries in ECOWAS.

The gross formation of fixed capital on the sample is worth on average 22.65% of GDP with variability that represents about 51% of the average. This variable has also a

heterogeneity at the sample level. This is the same situation between countries with about variability that is worth about 35% of the average.

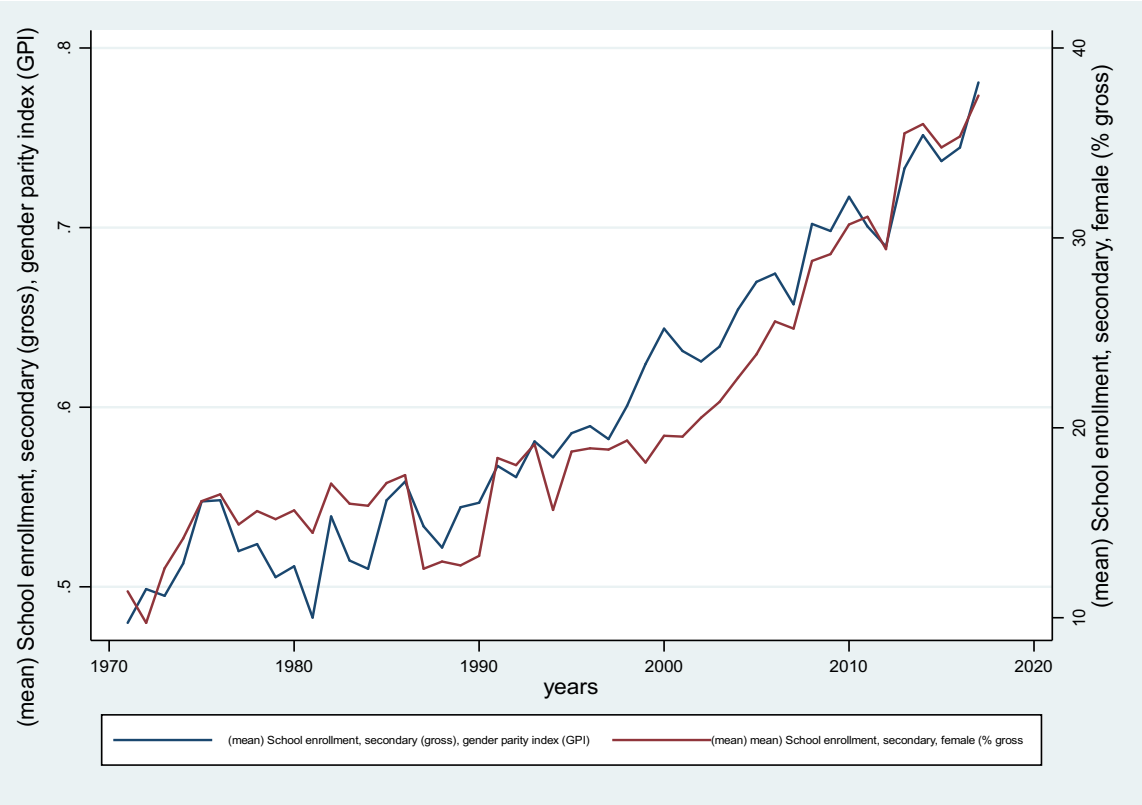
Between 1971 and 2017, an average of 52.14% of the sample population is between 15 and 64 years of age. The distribution of this variable over the entire sample is very homogeneous. Indeed, the variability is very low, and it is worth about 5% of the general average. This variability is 3% between each country over the period.

The distribution of the labour force is relatively homogeneous in ECOWAS. This reflects that the proportion of 15-64 in the total population is homogeneous in the sample.

Analysis of the parity index in secondary education enrolment shows that over the period, the average is 0.6. This value suggests that on average, girls are at a greater disadvantage than boys in learning opportunities in secondary school. Statistics show high variability of this indicator with 37% of the overall average over the whole sample, 33% of the average between countries. It appears that in secondary education, ECOWAS countries are not housed in the same way. The study shows a large disparity across the sample. Analysis of the gross enrolment rate of girls in secondary education shows an average value of 20.5% with high variability.

However, analysis of the evolution of the two indicators - the gender parity index in secondary education and the gross enrolment rate of girls in secondary education - reveals that efforts are being made to reduce gender inequalities in secondary education. Indeed, as can be seen in Graph 1, the trend of both indicators is bullish.

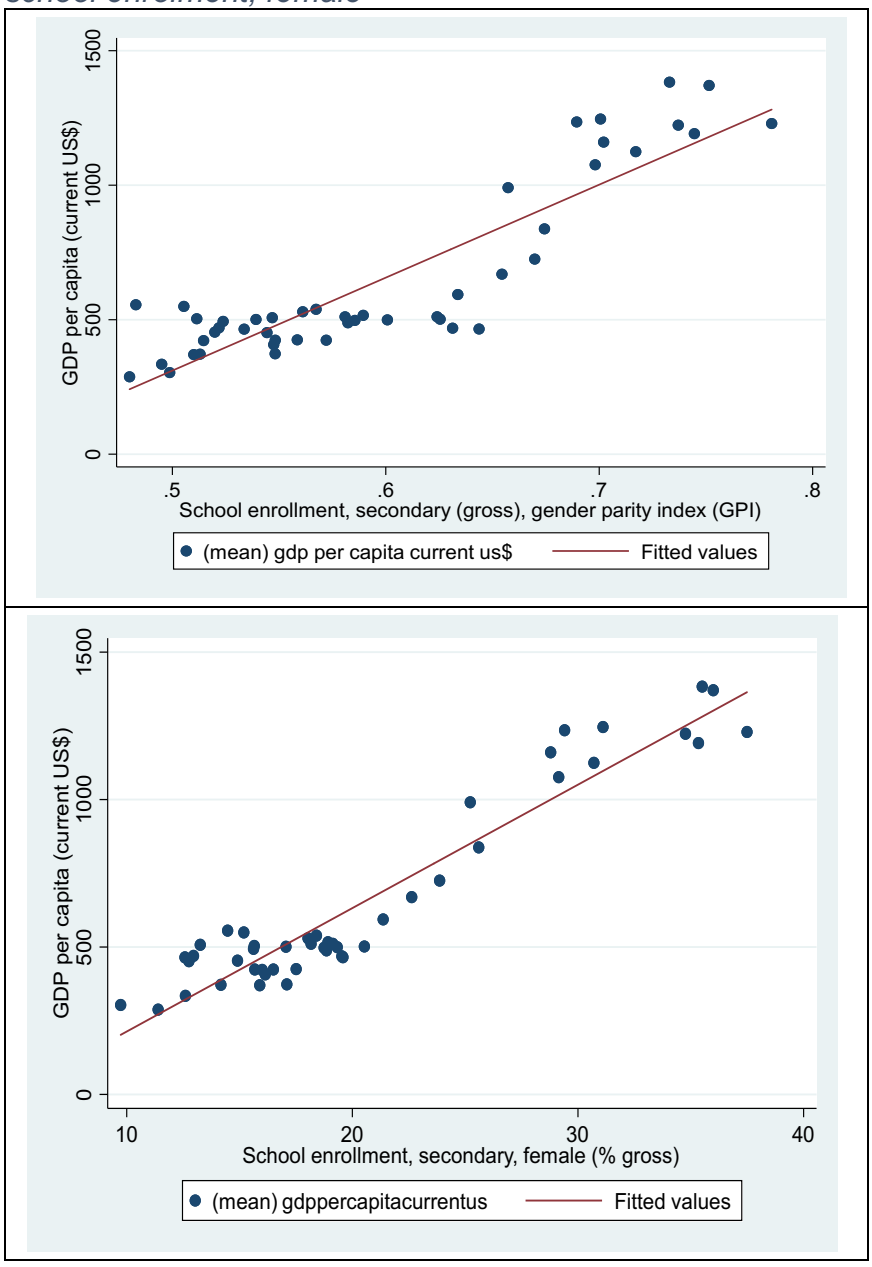
Graph 1: Gender parity index in secondary school and secondary school enrolment, female



Source: World development indicators, the author

This indicates a reduction in disparities in secondary and higher education between 1971 and 2017. Nevertheless, this disparity in education is associated with growth in per capita income over the period (see Graph 2).

Graph 2:GDP per capita and gender parity index secondary school and secondary school enrolment, female



Source: World development indicators, the author

The overall situation presented above (Graph 2) contrasts with the situation in each country. Indeed, the level of development of countries is not the same (*Appendix 2* and *Appendix 3*). ECOWAS is characterized by a high heterogeneity of countries both economically and socially as it was shown by the analysis of the descriptive statistics in Table 2. More details are presented in the table in Appendix 1

These positive relationships are confirmed by the correlation coefficients presented in Table 3. This table shows that per capita income is positively correlated with the gender parity indicator in secondary education on the one hand and the gross enrolment rate of girls in secondary education. The correlation coefficient is significant at the 5% level, and its value is high 0.64 and 0.74 respectively.

Table 2: Correlation matrix

Variables	1	2	3	4	5	6
GDP per capita (current US$) (1)	1					
Gross capital formation (% of GDP) (2)	0.34*	1				
Inflation, GDP deflator (annual %) (3)	-0.07	0.16*	1			
Population ages 15-64 (% of total) (4)	0.50*	0.09*	0.02	1		
School enrolment, secondary (gross), gender parity index (GPI) (5)	0.64*	0.47*	-0.06	0.21*	1	
School enrolment, secondary, female (% gross) (6)	0.74*	0.38*	-0.04	0.37*	0.85*	1

Note : * p<0.05, significative at 5%
Source: World development indicators, the author

4.2 | Empirical results

Stationarity tests on the variables reveal that the dependent variable is not stationary. We are dealing with variables I(1) and variables I(0). We use the unrestricted model and an information criterion, and we decide the choice of lags for each unit/group per variable. Then we choose the most common lag for each variable to represent the lags for the model. Doing so, the optimal lags selection lead to an ARDL (1,0,0,0,0,0) model (*Appendix 5*). We perform Pedroni's cointegration tests and the results (see the table in *Appendix 6*) show that there is cointegration between variables. The estimated model is written as follows:

$$\Delta\, lnGDPpp_{it} = a_0 + a_{1t}\,\Delta lnGDPpp_{it-1} + a_{2t}\,\Delta lnK_{it} + a_{3t}\,\Delta lnL_{it} + a_{4t}\,\Delta lnGPIsse_{it} + a_{5t}\,\Delta\, lnSSE_{it} + a_{6t}\,\Delta lnInflation_{it} + b_{1t} lnGDPpp_{it} + b_{2t}\, lnK_{it-1} + b_{3t}\, lnL_{it-1} + b_{4t}\, lnGPIsse_{it-1} + b_{5t} lnSSE_{it-1} + a_{6t}\, lnInflation_{it-1} + \varepsilon_{it} \quad \textit{Equation 8}$$

With $Inflation_{it-1}$ the control variable.

Then we estimate the model (*Equation 9)* with Pooled Mean Group (PMG) regression method. This approach considers the heterogeneity in the dynamics of adjustment of the variables towards the long-term relationship. And, the PMG estimator allows the short-term coefficients and the adjustment coefficient to vary depending on the country, but the long-term coefficients are the same for all countries. So, with this method of estimation, let us assume the existence of a common Community policy to reduce gender inequalities in long-term education, but in the short term, there are differences between member countries.

Results (columns 5.6.7 and 8) show that there is cointegration among variable in the panels. The Error Correction Term (ECT) is negative and significant at 1% level. So, there is a long run cointegration relation in the panel. So, any deviation from the long-run equilibrium is corrected.

Gender inequality in education has an impact on per capita income in ECOWAS so does many authors we mentioned in the literature review (Hill and King (1995), Klasen (1999, 2002), Knowles et al. (2002) and Abu-Ghaida and Klasen (2004), Duflo(2012) and Bandiera and Natraj (2013)). Reducing gender inequalities translates into an increase in the gross enrolment rate of girls in secondary education has a positive impact on per capita income in ECOWAS. This result is very closed to Amin, Veselin, & Martin, (2015) and Licumba, Dzator, & Zhang,(2015). They find that greater gender inequality is strongly associated with lower per capita income growth and there is a positive, robust and significant effect of gender equality in education on economic growth. Our results show that a 1% increase in the value of the school enrolment rate in secondary school for female (% gross) in ECOWAS leads, in the short run, to an increase in per capita income growth of 0.05% and the long term an increase of 0.09% at 1% level. The long-run effect is greater than the short-run effect. In both the long term and the short term, the gender parity index in secondary education has no significant effect on income per capita. The results are the same even when the macroeconomic environment is not controlled by taking the inflation rate into account in the estimate. The primary factors: capital and labour have positive and significant long-term effects on per capita income in ECOWAS.

Tableau 3: Estimation results Pooled Mean Group Regression

Dependant variable : $\Delta\, lnGDPpp_{it}$ (GDP per capita)					School enrolment, secondary (gross), gender parity index (GPI)		School enrolment, secondary, female (% gross) (SSE)	
VARIABLES	(1)	(2)	(3)	(4)	(5) Long run coefficients	(6) Short run coefficients	(7) Long run coefficients	(8) Short run coefficients
Error Correction Term		-0.12***		-0.13***		-0.12***		-0.12***
		(0.00)		(0.00)		(0.00)		(0.00)
ΔlnL_{it}		-1.61		-1.25		-1.38		-1.22
		(0.32)		(0.38)		(0.42)		(0.44)
ΔlnK_{it}		0.04		0.04		0.03		0.03
		(0.51)		(0.54)		(0.57)		(0.58)
$\Delta lnGPIsse_{it}$		0.09				0.08		
		(0.10)				(0.13)		
lnL_{it}	7.70***		7.67***		7.82***		7.92***	
	(0.00)		(0.00)		(0.00)		(0.00)	
lnK_{it}	0.63***		0.62***		0.65***		0.64***	
	(0.00)		(0.00)		(0.00)		(0.00)	
$lnGPIsse_{it}$	0.13				0.10			
	(0.49)				(0.59)			
$lnSSE_{it}$			0.09*				0.09*	
			(0.08)				(0.10)	
$\Delta\, lnSSE_{it}$				0.05*				0.05*
				(0.06)				(0.07)
$lnInflation_{it}$					-0.01		0.01	
					(0.77)		(0.86)	
$\Delta lnInflation_{it}$						0.02***		0.02**
						(0.00)		(0.01)
Constant		-3.09***		-3.31***		-3.07***		-3.31***
		(0.00)		(0.00)		(0.00)		(0.00)
Observations	598	598	598	598	598	598	598	598
ll	377.0	377.0	379.4	379.4	388.0	388.0	389.7	389.7

Note: p-value in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: The author

Among the countries in the sample, it should be noted that some of them deserve attention on the issue of the effect of gender inequalities in secondary education on per capita income. The results of the detailed estimates show that Burkina Faso, Guinea-Bissau and Niger have positive direct effects of the gender parity index in secondary education on per capita income (*Appendix 7*).

5 | Conclusion and Policy implications

This paper aims to analyse the effect of gender inequality in education on per capita income in the Economic Community of West African States (ECOWAS). To do so, we estimate a panel in which we consider the gender parity index in secondary school enrolment and secondary school enrolment rate (% female) as an indicator to assess gender parity in education. The results show that reducing gender inequality in education leads to increase per capita income growth in ECOWAS at both short and long run. A 1% increase in the value of the school enrolment rate in secondary school for female (% gross) in ECOWAS leads, in the short run, to an increase in per capita income growth of 0.05% and the long term an increase of 0.09% at 1% level. The long-run effect is greater than the short-run effect. In both term (short and long), the gender parity index in secondary education has no significant effect on per capita income.

These results motivate policies to reduce gender inequalities in education by increasing the school enrolment rate in secondary school for female (% gross). This policy will contribute to improve the income per capita. To achieve this goal, the following recommendations are made:

- Continue to undertake action to reduce gender inequalities in general, particularly in education;
- Strengthen the secondary education system in the sub-region to ensure the quality of training and promote girls' skills in general.
- Support member states in improving the gross enrolment rate of girls in secondary school. Indeed, member countries are not at the same time as the development of the secondary education system. It would be interesting to target countries such as Burkina Faso, Guinea Bissau and Niger. Specific support policies for these countries can be developed and implemented.

- Encourage the creation of girls' institutions in secondary education (High school and girls' college at the regional level

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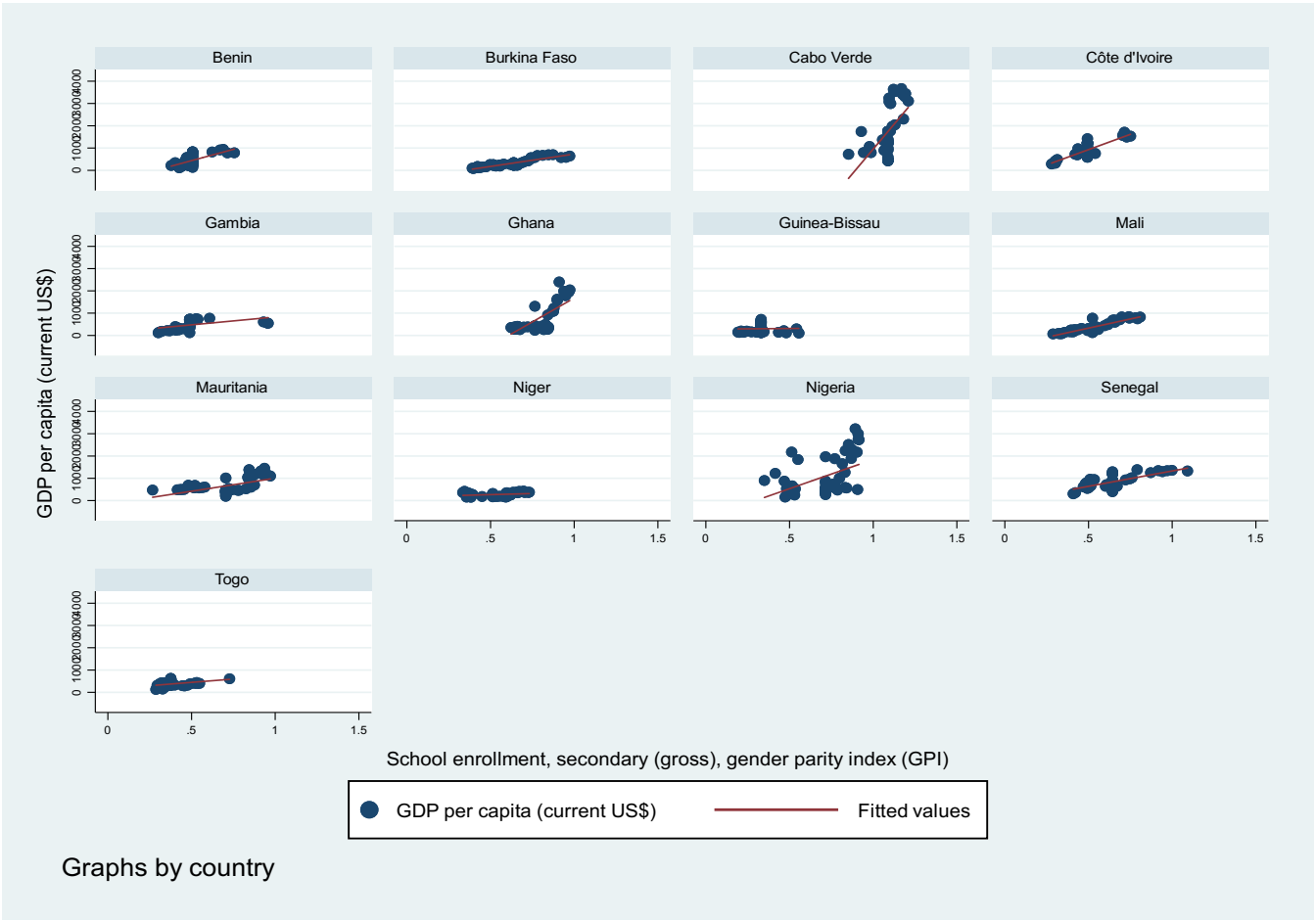
Appendix

Appendix 1*: Descriptive statistics*

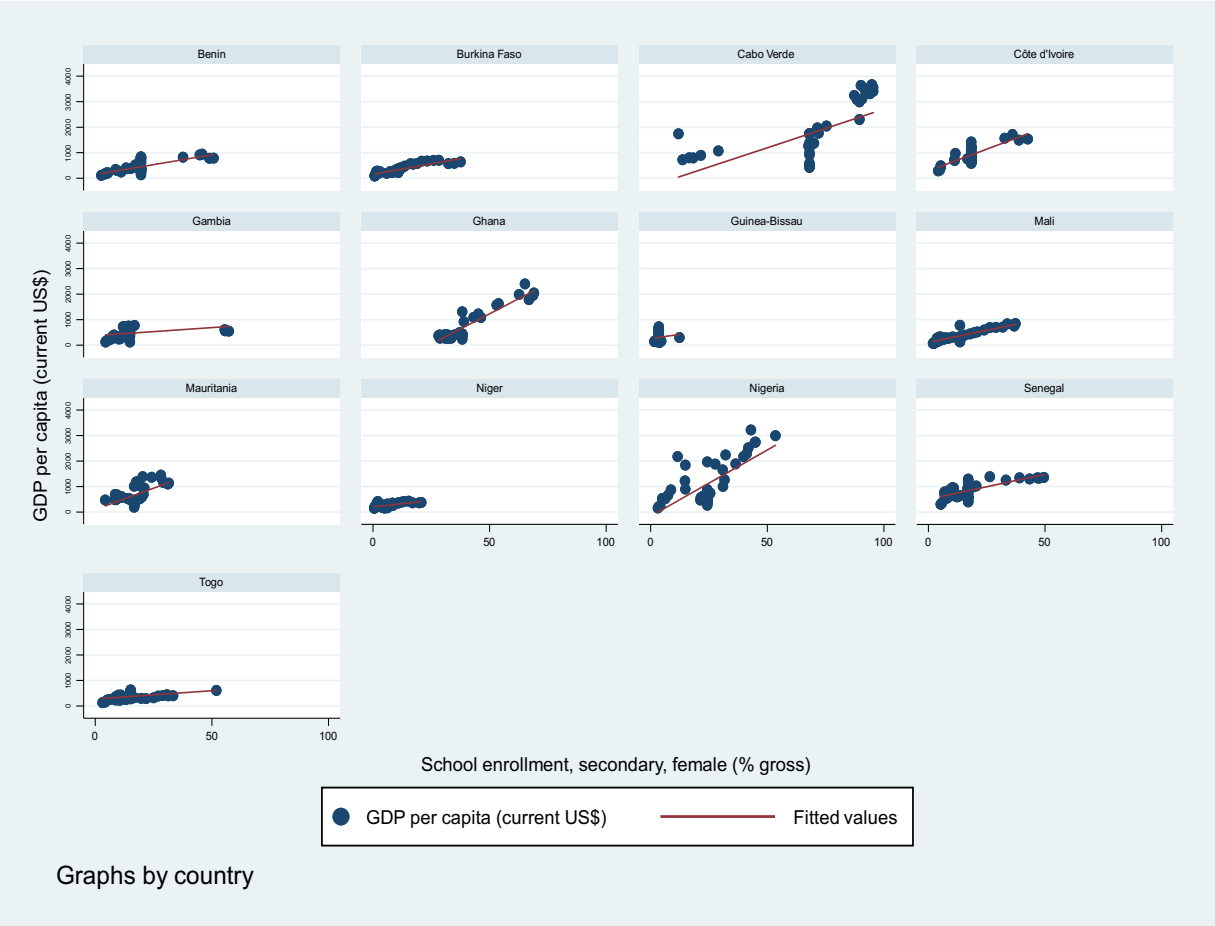
Variables		Mean	Std. Dev.	Min	Max	Observations
GDP per capita (current US$)	overall	652.72	603.71	71.15	3670.43	N = 611
	between		418.12	269.20	1742.86	n = 13
	within		450.36	663.44	2775.52	T = 47
Gross capital formation (% of GDP)	overall	22.65	11.57	3.15	89.38	N = 611
	between		7.99	15.28	40.45	n = 13
	within		8.64	0.89	74.92	T = 47
Inflation, GDP deflator (annual %)	overall	10.46	18.46	29.17	219.00	N = 611
	between		8.93	3.54	31.35	n = 13
	within		16.34	22.25	208.64	T = 47
Population ages 15-64 (% of total)	overall	52.14	2.50	46.66	65.33	N = 611
	between		1.37	48.89	54.20	n = 13
	within		2.12	45.98	64.66	T = 47
School enrollment, secondary (gross), gender parity index (GPI)	overall	0.6	0.22	0.19	1.21	N = 611
	between		0.19	0.33	1.09	n = 13
	within		0.12	0.16	1.07	T = 47
School enrollment, secondary, female (% gross)	overall	20.5	19.25	.55441	95.41	N = 611
	between		16.63929	3.50	68.09	n = 13
	within		10.7125	35.68	62.90	T = 47

Source: World development indicators, the author

Appendix 2: GDP per capita and school enrolment, secondary, gender parity index



Appendix 3: GDP per capita and secondary school enrolment (% female)



Source: The author, World Bank data (WDI)

Appendix 4: Unit root test at level

		At level (with trend)	
Unit-root tests	Im-Pesaran-Shin unit-root test	Augmented Dickey-Fuller tests	Conclusions
Lngdp	-1.5242 (0.0637)	-1.5879 (0.0584)	All panels contain unit roots
LnK	-2.2705 (0.0116)	-2.4976 (0.0074)	At least one panel is stationary
LnL	-0.7619 (0.2231)	-0.9379 (0.1758)	All panels contain unit roots
LnDefla	-9.9116 (0.0000)	-13.3415 (0.0000)	At least one panel is stationary
LnSSE_PI	-4.7805 (0.0000)	-5.3686 (0.0000)	At least one panel is stationary
LnSSE_G	-3.3795 (0.0004)	-3.7719 (0.0002)	At least one panel is stationary

Note: p value ()
Source: The author calculations

Appendix 5: Optimal lags selection

	Lngdp	LnK	LnL	LnSSE_PI	LnTBS_F	LnDefla
ARDL(1,1,0,0,0,0)	1	1	0	0	0	0
ARDL(1,0,0,0,0,0)	1	0	0	0	0	0
ARDL(1,0,0,0,0,0)	1	0	0	0	0	0
ARDL(2,0,0,0,0,0)	2	0	0	0	0	0
ARDL(1,0,0,0,0,0)	1	0	0	0	0	0
ARDL(2,0,1,0,0,0)	2	0	1	0	0	0
ARDL(1,1,0,0,2,0)	1	1	0	0	2	0
ARDL(1,0,0,0,0,0)	1	0	0	0	0	0
ARDL(2,0,1,0,0,1)	2	0	1	0	0	1
ARDL(2,1,0,0,0,0)	2	1	0	0	0	0
ARDL(1,1,0,1,0,0)	1	1	0	1	0	0
ARDL(1,0,0,0,0,0)	1	0	0	0	0	0
ARDL(1,0,0,0,0,0)	1	0	0	0	0	0
Nombre de 0	0	9	11	12	12	12
Nombre de 1	9	4	2	1	0	1
Nombre de 2	4	0	0	0	1	0
ARDL	**1**	**0**	**0**	**0**	**0**	**0**

Source: The author calculations

Appendix 6: Pedroni's cointegration test

Test	Stats.	Panel	Group	Conclusions
	v	-.6235	.	
	rho	.5517	1.155	cointegration
	t	-.6611	-.3825	cointegration
	ADF	.2727	.8445	cointegration

Source: The author calculations

Appendix 7: Estimation with the full option (Gender parity index) by country

D.Lngdp	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Benin						
ECT	**-.1579313**	**.0655199**	**-2.41**	**0.016**	**-.2863479**	**-.0295147**
LnL						
D1.	6.264605	8.341503	0.75	0.453	-10.08444	22.61365

LnK						
D1.	.1134671	.0907379	1.25	0.211	-.0643758	.29131
LnSSE_PI						
D1.	.0919684	.1517144	0.61	0.544	-.2053863	.3893231
LnDefla						
D1.	-.0016404	.012638	-0.13	0.897	-.0264104	.0231296
_cons	-4.182137	1.892693	-2.21	0.027	-7.891747	-.4725269
Burkina Faso						
ECT	**-.0947332**	**.0397906**	**-2.38**	**0.017**	**-.1727214**	**-.016745**
LnL						
D1.	.8049915	5.495237	0.15	0.884	-9.965476	11.57546
LnK						
D1.	-.0881481	.1071	-0.82	0.410	-.2980604	.1217641
LnSSE_PI						
D1.	.3278455	.1836859	1.78	**0.074**	-.0321722	.6878633
LnDefla						
D1.	.0113266	.0129053	0.88	0.380	-.0139673	.0366205
_cons	-2.51906	1.147941	-2.19	0.028	-4.768983	-.2691382
Cabo Verde						
ECT	**-.1392334**	**.0565263**	**-2.46**	**0.014**	**-.250023**	**-.0284439**
LnL						
D1.	-5.729479	4.939766	-1.16	0.246	-15.41124	3.952284
LnK						
D1.	.2449938	.4140776	0.59	0.554	-.5665834	1.056571
LnSSE_PI						
D1.	.0131772	.4894597	0.03	0.979	-.9461463	.9725006
LnDefla						
D1.	.0566254	.0337886	1.68	0.094	-.0095991	.1228498
_cons	-3.582475	1.462965	-2.45	0.014	-6.449833	-.7151161
Côte d'Ivoire						
ECT	**-.1064038**	**.046554**	**-2.29**	**0.022**	**-.1976478**	**-.0151597**
LnL						
D1.	-6.353612	7.998315	-0.79	0.427	-22.03002	9.322798
LnK						
D1.	-.0005832	.0569287	-0.01	0.992	-.1121615	.110995
LnSSE_PI						
D1.	.2595586	.1895879	1.37	0.171	-.1120268	.631144
LnDefla						
D1.	.0077472	.013316	0.58	0.561	-.0183516	.033846
_cons	-2.721262	1.315994	-2.07	0.039	-5.300564	-.1419602
Gambia						
ECT	**-.084235**	**.0394158**	**-2.14**	**0.033**	**-.1614885**	**-.0069815**
LnL						
D1.	.1656694	5.910697	0.03	0.978	-11.41908	11.75042
LnK						
D1.	-.0744241	.0656798	-1.13	0.257	-.2031542	.054306
LnSSE_PI						
D1.	.1176175	.123347	0.95	0.340	-.1241382	.3593732
LnDefla						

D1.	.0360971	.0185042	1.95	0.051	-.0001704	.0723647
_cons	-2.184985	1.096455	-1.99	0.046	-4.333999	-.0359722
Ghana						
ECT	**-.0271374**	**.0472855**	**-0.57**	**0.566**	**-.1198153**	**.0655406**
LnL						
D1.	4.196821	14.80659	0.28	0.777	-24.82356	33.2172
LnK						
D1.	.0219294	.074355	0.29	0.768	-.1238037	.1676625
LnSSE_PI						
D1.	.0856312	.3801836	0.23	0.822	-.6595148	.8307773
LnDefla						
D1.	.0608763	.0375156	1.62	0.105	-.012653	.1344055
_cons	-.6955379	1.27362	-0.55	0.585	-3.191787	1.800712
Guinea-Bissau						
ECT	**-.052788**	**.0343063**	**-1.54**	**0.124**	**-.1200271**	**.0144511**
LnL						
D1.	8.275834	4.756451	1.74	0.082	-1.046639	17.59831
LnK						
D1.	.0557466	.0701801	0.79	0.427	-.0818039	.1932971
LnSSE_PI						
D1.	.225516	.1067865	2.11	**0.035**	.0162184	.4348136
LnDefla						
D1.	.0071054	.0164882	0.43	0.667	-.0252109	.0394218
_cons	-1.388946	.9797299	-1.42	0.156	-3.309181	.5312896
Mali						
ECT	**-.0348424**	**.0274504**	**-1.27**	**0.204**	**-.0886442**	**.0189594**
LnL						
D1.	-1.943154	6.051405	-0.32	0.748	-13.80369	9.917382
LnK						
D1.	.0371026	.1237895	0.30	0.764	-.2055205	.2797256
LnSSE_PI						
D1.	.1275292	.1264131	1.01	0.313	-.1202359	.3752943
LnDefla						
D1.	.0036223	.0207798	0.17	0.862	-.0371054	.04435
_cons	-.8894393	.7423385	-1.20	0.231	-2.344396	.5655174
Mauritania						
ECT	**-.1283067**	**.0551594**	**-2.33**	**0.020**	**-.2364171**	**-.0201963**
LnL						
D1.	-12.06673	9.196878	-1.31	0.190	-30.09228	5.958822
LnK						
D1.	-.018407	.0399711	-0.46	0.645	-.0967489	.0599348
LnSSE_PI						
D1.	-.0325628	.0625786	-0.52	0.603	-.1552146	.0900891
LnDefla						
D1.	.033214	.0130793	2.54	0.011	.0075789	.058849
_cons	-3.374679	1.54907	-2.18	0.029	-6.4108	-.3385572
Niger						
ECT	**-.2903292**	**.0620328**	**-4.68**	**0.000**	**-.4119112**	**-.1687471**
LnL						
D1.	-.2521573	7.059411	-0.04	0.972	-14.08835	13.58403

LnK						
D1.	-.058211	.0519974	-1.12	0.263	-.160124	.0437019
LnSSE_PI						
D1.	-.3713723	.1928374	-1.93	**0.054**	-.7493267	.0065821
LnDefla						
D1.	.001402	.0136814	0.10	0.918	-.0254131	.028217
_cons	-7.69724	2.054988	-3.75	0.000	-11.72494	-3.669538
Nigeria						
ECT	**-.0390386**	**.0314075**	**-1.24**	**0.214**	**-.1005962**	**.022519**
LnL						
D1.	-11.24411	12.10039	-0.93	0.353	-34.96044	12.47221
LnK						
D1.	.4329386	.1869253	2.32	0.021	.0665717	.7993054
LnSSE_PI						
D1.	.2199493	.1916743	1.15	0.251	-.1557254	.595624
LnDefla						
D1.	.061414	.0271283	2.26	0.024	.0082434	.1145845
_cons	-.9843533	.8589524	-1.15	0.252	-2.667869	.6991623
Senegal						
ECT	**-.119922**	**.0476996**	**-2.51**	**0.012**	**-.2134114**	**-.0264326**
LnL						
D1.	-1.663575	4.327746	-0.38	0.701	-10.1458	6.818652
LnK						
D1.	-.2528554	.1316555	-1.92	0.055	-.5108955	.0051847
LnSSE_PI						
D1.	.132635	.1042274	1.27	0.203	-.0716469	.3369169
LnDefla						
D1.	-.0129903	.0153244	-0.85	0.397	-.0430255	.0170449
_cons	-3.096268	1.327368	-2.33	0.020	-5.697861	-.4946749
Togo						
ECT	**-.2466442**	**.0607613**	**-4.06**	**0.000**	**-.3657342**	**-.1275542**
LnL						
D1.	1.6328	5.346718	0.31	0.760	-8.846574	12.11217
LnK						
D1.	-.0658196	.0730282	-0.90	0.367	-.2089523	.0773131
LnSSE_PI						
D1.	-.1740896	.144826	-1.20	0.229	-.4579433	.1097641
LnDefla						
D1.	.0087212	.015806	0.55	0.581	-.022258	.0397004
_cons	-6.603004	1.919273	-3.44	0.001	-10.36471	-2.841298

Appendix 8: Estimation with the full option (Secondary school enrolment, gross (% female) by country

D.Lngdp	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Benin						
ECT	**-.1584253**	**.0683093**	**-2.32**	**0.020**	**-.2923091**	**-.0245414**
LnL						
D1.	5.713175	8.346973	0.68	0.494	-10.64659	22.07294
LnK						
D1.	.1189104	.0909899	1.31	0.191	-.0594266	.2972474
LnTBS_F						
D1.	.000135	.0316065	0.00	0.997	-.0618125	.0620826
LnDefla						
D1.	-.0017524	.0123141	-0.14	0.887	-.0258876	.0223828
_cons	-4.30749	2.010824	-2.14	0.032	-8.248632	-.3663487
Burkina Faso						
ECT	**-.1130484**	**.042765**	**-2.64**	**0.008**	**-.1968662**	**-.0292305**
LnL						
D1.	1.164567	5.381768	0.22	0.829	-9.383503	11.71264
LnK						
D1.	-.0930093	.1072778	-0.87	0.386	-.3032699	.1172513
LnTBS_F						
D1.	.0437103	.0336426	1.30	0.194	-.0222279	.1096486
LnDefla						
D1.	.0070764	.0128767	0.55	0.583	-.0181616	.0323143
_cons	-3.079323	1.282972	-2.40	0.016	-5.593902	-.5647435
Cabo Verde						
ECT	**-.1375863**	**.056298**	**-2.44**	**0.015**	**-.2479283**	**-.0272443**
LnL						
D1.	-6.17711	5.038643	-1.23	0.220	-16.05267	3.698449
LnK						
D1.	.2414184	.414732	0.58	0.560	-.5714413	1.054278
LnTBS_F						
D1.	-.0116124	.0594659	-0.20	0.845	-.1281633	.1049386
LnDefla						
D1.	.0554278	.0340451	1.63	0.104	-.0112994	.1221549
_cons	-3.638396	1.492269	-2.44	0.015	-6.563189	-.7136031
Côte d'Ivoire						
ECT	**-.1135375**	**.0475459**	**-2.39**	**0.017**	**-.2067258**	**-.0203493**
LnL						
D1.	-5.746847	8.019612	-0.72	0.474	-21.465	9.971304
LnK						
D1.	-.0029536	.0571931	-0.05	0.959	-.1150501	.1091428
LnTBS_F						
D1.	.0823122	.0731437	1.13	0.260	-.0610468	.2256711
LnDefla						
D1.	.0050199	.0132439	0.38	0.705	-.0209377	.0309775
_cons	-2.98757	1.393294	-2.14	0.032	-5.718376	-.2567646

Gambia						
ECT	**-.0859082**	**.0395758**	**-2.17**	**0.030**	**-.1634754**	**-.008341**
LnL						
D1.	-.2150095	5.920014	-0.04	0.971	-11.81802	11.388
LnK						
D1.	-.0736249	.0660726	-1.11	0.265	-.2031249	.0558751
LnTBS_F						
D1.	.0269361	.0573791	0.47	0.639	-.0855249	.139397
LnDefla						
D1.	.0336426	.0186092	1.81	0.071	-.0028306	.0701159
_cons	-2.290052	1.131984	-2.02	0.043	-4.5087	-.0714046
Ghana						
ECT	**-.0357528**	**.0472572**	**-0.76**	**0.449**	**-.1283752**	**.0568696**
LnL						
D1.	4.982983	14.31495	0.35	0.728	-23.0738	33.03977
LnK						
D1.	.0178836	.0723294	0.25	0.805	-.1238794	.1596467
LnTBS_F						
D1.	.2922633	.1905163	1.53	0.125	-.0811417	.6656684
LnDefla						
D1.	.0574572	.0367047	1.57	0.117	-.0144828	.1293972
_cons	-.9600464	1.315425	-0.73	0.465	-3.538232	1.618139
Guinea-Bissau						
ECT	**-.039888**	**.0332818**	**-1.20**	**0.231**	**-.105119**	**.0253431**
LnL						
D1.	6.702981	4.568558	1.47	0.142	-2.251228	15.65719
LnK						
D1.	.0628518	.0682496	0.92	0.357	-.0709149	.1966186
LnTBS_F						
D1.	.1747608	.0632855	2.76	0.006	.0507236	.298798
LnDefla						
D1.	-.0105763	.0176515	-0.60	0.549	-.0451725	.02402
_cons	-1.065894	.9528974	-1.12	0.263	-2.933539	.8017505
Mali						
ECT	**-.0367353**	**.0285389**	**-1.29**	**0.198**	**-.0926705**	**.0191999**
LnL						
D1.	-2.654151	6.236811	-0.43	0.670	-14.87808	9.569774
LnK						
D1.	.0329116	.1228187	0.27	0.789	-.2078086	.2736317
LnTBS_F						
D1.	.042939	.037754	1.14	0.255	-.0310575	.1169354
LnDefla						
D1.	.0033602	.020603	0.16	0.870	-.037021	.0437415

_cons	-.9661337	.7918002	-1.22	0.222	-2.518034	.5857661
Mauritania						
ECT	**-.1282959**	**.05308**	**-2.42**	**0.016**	**-.2323309**	**-.024261**
LnL						
D1.	-11.74198	9.098478	-1.29	0.197	-29.57467	6.090714
LnK						
D1.	-.0190862	.0395394	-0.48	0.629	-.0965819	.0584095
LnTBS_F						
D1.	-.0299761	.0453357	-0.66	0.508	-.1188325	.0588803
LnDefla						
D1.	.0312595	.0129748	2.41	0.016	.0058294	.0566896
_cons	-3.462983	1.503996	-2.30	0.021	-6.410762	-.5152046
Niger						
ECT	**-.3603411**	**.0728919**	**-4.94**	**0.000**	**-.5032066**	**-.2174756**
LnL						
D1.	2.436272	7.135509	0.34	0.733	-11.54907	16.42161
LnK						
D1.	-.0837957	.0537809	-1.56	0.119	-.1892044	.021613
LnTBS_F						
D1.	-.0952418	.0763621	-1.25	0.212	-.2449088	.0544252
LnDefla						
D1.	-.0010225	.0142096	-0.07	0.943	-.0288728	.0268279
_cons	-9.768835	2.577117	-3.79	0.000	-14.81989	-4.717778
Nigeria						
ECT	**-.0355139**	**.0318247**	**-1.12**	**0.264**	**-.0978892**	**.0268615**
LnL						
D1.	-8.599249	12.0766	-0.71	0.476	-32.26895	15.07045
LnK						
D1.	.4504309	.1846994	2.44	0.015	.0884267	.8124352
LnTBS_F						
D1.	.1302401	.0790559	1.65	**0.099**	-.0247065	.2851868
LnDefla						
D1.	.0559662	.0270886	2.07	0.039	.0028736	.1090588
_cons	-.9185415	.8890268	-1.03	0.302	-2.661002	.823919
Senegal						
ECT	**-.118762**	**.0478094**	**-2.48**	**0.013**	**-.2124667**	**-.0250574**
LnL						
D1.	-1.604221	4.30278	-0.37	0.709	-10.03751	6.829073
LnK						
D1.	-.2545318	.1312126	-1.94	**0.052**	-.5117037	.0026402
LnTBS_F						
D1.	.0589654	.0442951	1.33	0.183	-.0278514	.1457821
LnDefla						
D1.	-.0141139	.0152049	-0.93	0.353	-.0439151	.0156872
_cons	-3.145967	1.348276	-2.33	0.020	-5.78854	-.5033934

Togo						
ECT	**-.2361868**	**.0644514**	**-3.66**	**0.000**	**-.3625092**	**-.1098645**
LnL						
D1.	-.1130614	5.348382	-0.02	0.983	-10.5957	10.36957
LnK						
D1.	-.0523878	.075259	-0.70	0.486	-.1998928	.0951172
LnTBS_F						
D1.	-.0418542	.0731848	-0.57	0.567	-.1852938	.1015854
LnDefla						
D1.	.0077028	.0157723	0.49	0.625	-.0232104	.038616
_cons	-6.491631	1.988249	-3.26	0.001	-10.38853	-2.594734