SCIREA Journal of Economics

http://www.scirea.org/journal/Economics

April 17, 2022

Volume 7, Issue 2, April 2022

https://doi.org/10.54647/economics79285

THE EFFECT OF GENDER PARITY IN EDUCATION ON INCOME PER CAPITA IN WEST AFRICA

Doukoure Charles FE

Ecole Nationale Supérieure de Statistique et d'Economie Appliquée (ENSEA) and Cellule d'Analyse de Politiques Economiques du Cires (CAPEC), Ivory Coast

Abstract

This paper aims to analyse the effect of gender parity in education on per capita income in West Africa. We set a theoretical function in which seeking gender parity increase total factor productivity with a specific bonus on labour contribution in GDP per capita. We use a panel of 13 countries, considering secondary and tertiary education equality. Results reveal substantial inequality in education among countries at both levels of education. This inequality is favourable to boys as the average level of the gender parity index is lower than one. Only Capo Verde records a different situation in education. In this country, inequality is favourable to females.

Then we show that reducing gender inequality at both stages of education positively affects GDP per capita on average. When we assume a potential bonus from reducing this gender inequality, it appears that that reducing gender inequality in tertiary school enrolment positively affects GDP per capita with a bonus.

Keywords: Gender parity, education, income per capita

1. Introduction

The analysis of gender disparities 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, Africa has reduced inequalities in education (Klasen, 2017; World Bank, 2011). The number of girls enrolled in primary education is higher than ever, and more girls than boys are registered 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). Then obtain gender parity remains essential for development purposes in developing countries.

In the West Africa region, the relatively good economic performance of the past two decades has not addressed disparities of any kind. Inequality has reached significant levels in the area, so the per capita income gap between the richest (minority) and the least wealthy (predominantly) has grown over the years (Hallum & Obeng, 2019). According to this study, disparities are also glaring, whether in terms of per capita incomes, education, access to the labour market, access to health, representation of women in decision-making bodies. The Economic Community of West African States (ECOWAS) Commission has understood the need to integrate gender to strengthen 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, harmonise, coordinate, and implement the appropriate policies and mechanisms to improve women's economic, social, and cultural conditions. The ECOWAS Gender Development Centre (EGDC) is an ECOWAS specialised 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 an engine of regional integration and a full-fledged development objective. EGDC advocates are implementing existing commitments and mechanisms to ensure gender equality in the ECOWAS region in collaboration with its partners.

Gender parity in education remains a concern for policymakers in this region because equality is a fundamental human right. It represents an essential source of sustainable economic growth, employment, and productivity. What effect does gender inequality in education have 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. This paper fills the gap on this question for a sample of ECOWAS countries. It assesses the net gains in terms of GDP per capita due to reducing gender inequality in education. To better defend one's rights, position oneself on the labour market, better control one's fertility, and 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 and the improvement of the population's living conditions. 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 organised in 3 sections. The first section offers 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

This literature review looks at a theoretical framework and presents empirical studies on the interaction between gender parity and GDP per capita.

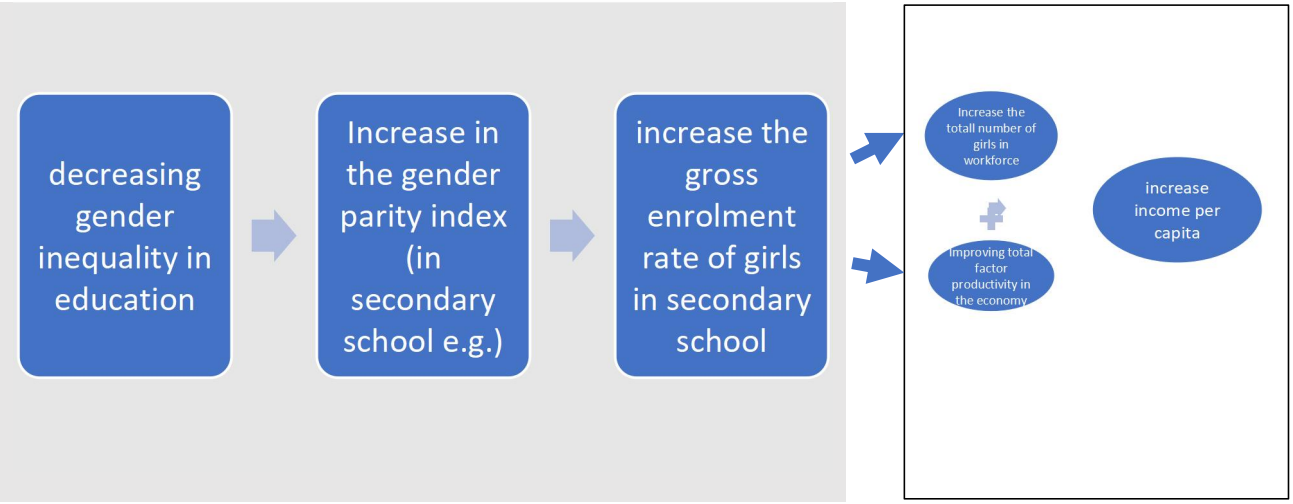
2.1. Gender parity in education and economic growth: a theoretical framework

The theoretical framework of this analysis is endogenous growth theory. Endogenous growth theories show that growth is an autonomous phenomenon enabled by the accumulation of physical capital, technology, public capital, and human capital. The collection of these factors is characterised by growth in yields and positive external effects that catalyse economic growth. This study is part of the theoretical framework of endogenous growth, emphasising the impact of human capital. Schultz and Becker highlighted human capital. 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 invests in training and education to increase his skills. 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.

Therefore, the increase in potential employment combined with the productivity improvement explained by training leads to a rise in output and overall income. This process improves income per capita (Figure 1).

Figure 1: Theoretical framework of the analysis



Source: The author

So seeking gender parity in education in this analysis will increase the gross enrolment rate of girls compared to that of boys in secondary and tertiary school. This increase in the per capita income will lead to new investments in the education sector, which will help reduce the disparity between girls and boys in education.

2.2. Gender parity in education interaction with economic growth: a brief literature review.

Seeking gender parity in education leads to reducing gender inequality in education. This goal impacts economic growth according to the theoretical framework above. Several empirical studies have attempted to estimate the impact of gender inequalities on economic growth and evaluate the growth gains that greater equality could generate. According to a survey 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 GDP per capita growth rate between the

two groups of countries between 1960 and 2000. The same study also confirms the existence of two kinds of adverse effects of gender inequalities, 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, unlike most studies, the three authors measure gender inequality beyond gender inequalities in education. On the other hand, they examine the heterogeneity likely to be the relationship between gender inequalities and growth, mainly according to the country's income level. Thus, they seek to determine whether gender inequalities and economic developments are substitutes or complements 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 development can be explained by data from developing 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 low living standards and high gender inequalities characterise developing countries, they can reduce gender inequalities and stimulate their economic development 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 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, reducing gender inequalities in education favours the latter. Several empirical studies have shown a negative relationship between gender inequalities in education and standard of living. From data for the 1975-1985 period, Hill & Elizabeth (1995) find a statistically and economically significant negative correlation between the achievement gap in primary and secondary education and per capita GDP. They concluded that gender inequality in education hurts rural poverty. The empirical findings suggest that the female-male enrolment ratio, female-male literacy ratio, the female-male ratio of total years of schooling, the female-male ratio of earners and education of household heads 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 panel data of five Southern African countries between 1970 and 2010. The evidence presented in this analysis suggests 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 and raise education quality, 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. On the one hand, it uses 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 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. A negative relationship between gender inequality in education breaks living condition indicators. So, indicators of living conditions are deteriorating with increased disparities in education.

Ultimately, the literature shows that gender inequalities influence countries' economic performance. Gender inequality in education is one of the effective channels of gender inequality that impacts 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 upbeat, and this reflects the fact that more gender inequality in education further promotes economic growth. The negative relationship shows that this gender inequality is a shortfall for wealth creation. After this ambiguous relationship, we consider gender inequality a bonus or a malus factor on income per capita.

Nevertheless, such empirical analysis has not been conducted for west African countries pointed out this potential bonus or malus effect of gender inequality on the global income. What is the impact of gender inequalities in education on income per capita in ECOWAS? And what will be the net gains after reducing gender inequality in education? The following section presents the methodology and data used for this analysis.

3. Methodology and data

This section presents the model specification and the data used.

3.1. Model specification

We consider a Cobb Douglas production function:

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

with Y_{it}, L_{it}, K_{it} et A_{it} respectively the GDP per capita (current level in US$), the labour force (percentage in total population), the stock of capital (gross capital formation % in GDP) and

the total factor productivity. Then we assume that the gender parity index in education will create a bonus or a malus on GDP per capita via the labour force $\theta = \alpha + \gamma GPI$ and increasing the total factor productivity $A_{it} = A_0 \ \ GPI_{it}^{w}$ in equation 1. Then we transform Equation 1 as follow:

$$Y_{it} = A_0 \ \ GPI_{it}^{w} \ L_{it}^{\alpha+\gamma GPI} \ K_{it}^{\beta} \qquad \textit{Equation 2}$$

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

$$\tilde{y}_{it} = a_0 + w\ gpi_{it} + (\alpha + \gamma GPI)\ l_{it} + \ \beta\ k_{it} \qquad \textit{Equation 3}$$

and,

$$\tilde{y}_{it} = a_0 + w\ gpi_{it} + \alpha l_{it} + \gamma GPI\ l_{it} + \ \beta\ k_{it} \qquad \textit{Equation 4}$$

If γ is positive (negative), gender inequality induces a bonus (malus) for GDP per capita. The final econometric specification is:

$$\tilde{y}_{it} = a_0 + w\ gpi_{it} + \alpha l_{it} + \gamma GPI\ l_{it} + \ \beta\ k_{it} + \vartheta\ Z_{it} + \varepsilon_{it} \qquad \textit{Equation 5}$$

With Z_{it} a control variable and ε_{it} the error term.

3.2. Data

Data are from 1971 to 2016. The average imputed the missing data for other countries over the period for each variable. The database is a panel of 13 countries of the Economic Community of West African States, including Mauritania, except for Guinea, Liberia, and Sierra Leone (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 secondary School enrolment,	
Gender parity index (GPI) in Tertiary School enrolment,	
Inflation, GDP deflator (annual %)	

Source: the author

The Gender Parity Index (GPI) is a socioeconomic index usually designed to measure males and females' relative access to education. UNESCO releases this index. In its simplest form, it

is calculated as the quotient of the number of females by the number of males enrolled in each stage of education (primary, secondary, tertiary). A GPI equal to one signifies equality between males and females. A GPI less than one indicates that gender parity favours males, while a GPI greater than one means gender parity tends females. The closer a GPI is to one, the closer a country achieves equality of access between males and females.

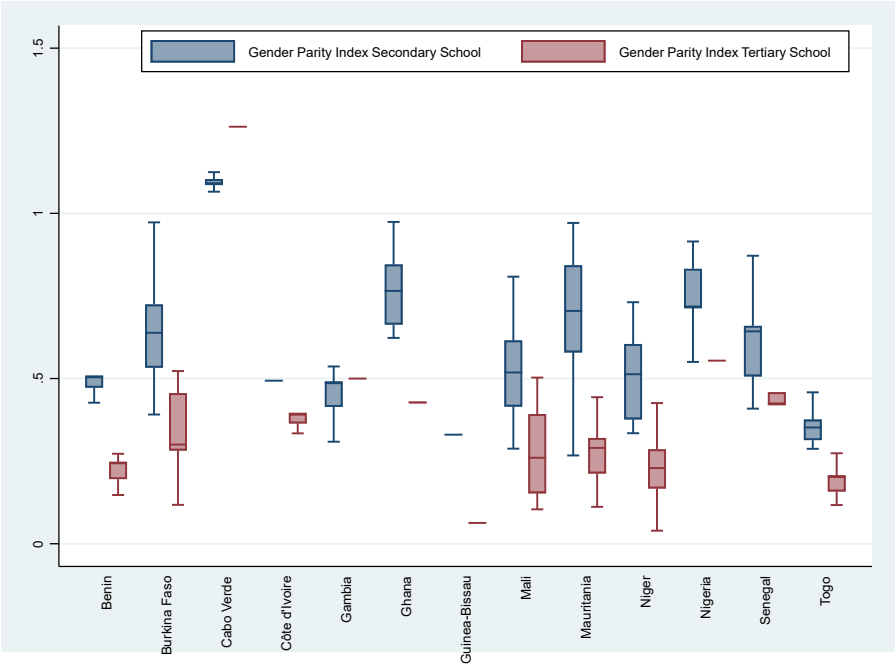
4. Main findings

This section presents a state of gender inequality in the sample and assesses the effect of gender inequality on GDP per capita.

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

Data on gender inequality in the panel describe a very heterogeneous situation. Only Capo Verde record a condition favourable for females. Because, as we can see in figure 2, on average, the GPI (secondary and tertiary school) is more significant than one. We notice an index lower than one on average for the other twelve countries. In these countries, on the contrary, the education state is not favourable for women.

Graph 1: Gender parity index in education the sample by country



Source: The authors with World Development Indicators data

In the sample, as we can see in this table, either in secondary school or tertiary school, the education situation is not favourable for women. On average, the GPI in secondary school enrolment is 0.59, and in tertiary school, the index is 0.39.

Table 2: Descriptive statistics for the GPI

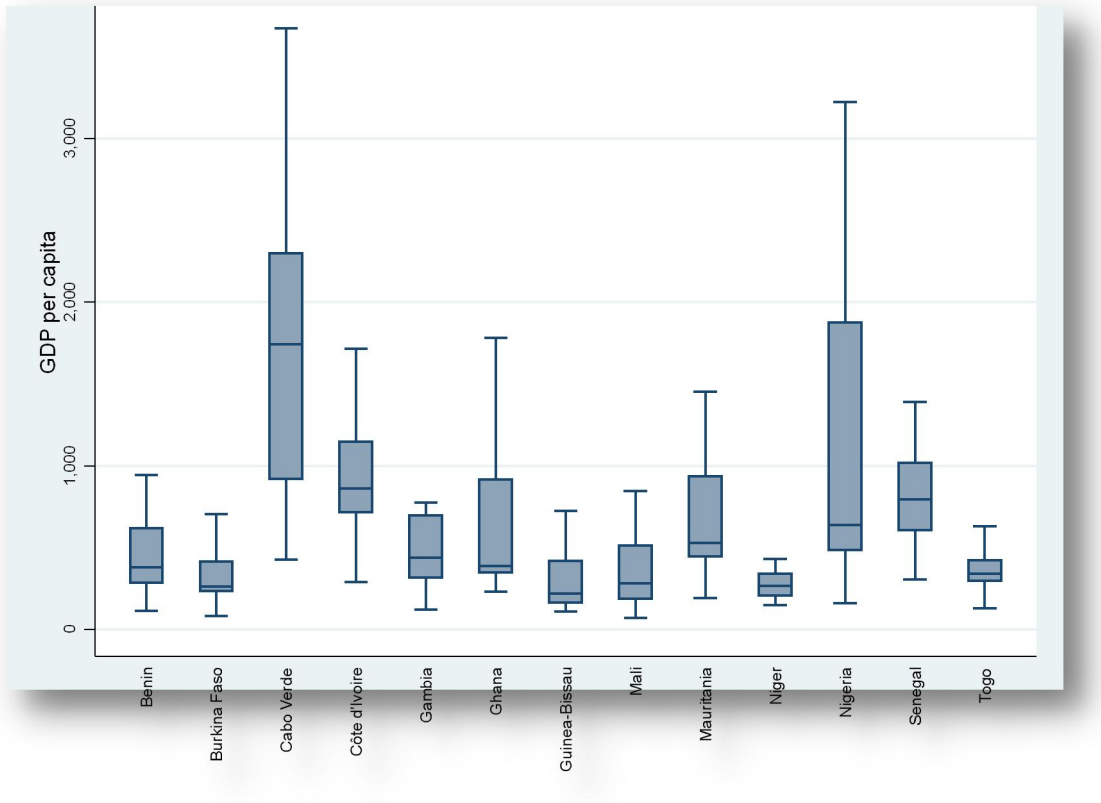
Variables		Mean	Std. Dev.	Min	Max	Observations
GPI Secondary School	overall	0.5989	0.222	0.192	1.209	N = 611
	between		0.196	0.330	1.088	n = 13
	within		0.117	0.161	1.068	T = 47
GPI Tertiary School	overall	0.3993	0.296	0.039	1.452	N = 611
	between		0.291	0.063	1.262	n = 13
	within		0.096	0.121	0.703	T = 47

Source: The author with World Development Indicators, data

Form this situation to reach equality in secondary school enrolment, respectively in tertiary school; the GPI will rise by 67% and 150%. As we can see, much more effort could be undertaken in tertiary school than in secondary school.

As the literature review has mentioned, the interaction between gender inequality and GDP per capita depends on the level of development of each country (Amin, Veselin, & Martin, 2015); we present on graph 2 the situation of each country.

Graph 2: GDP per capita distribution in the sample

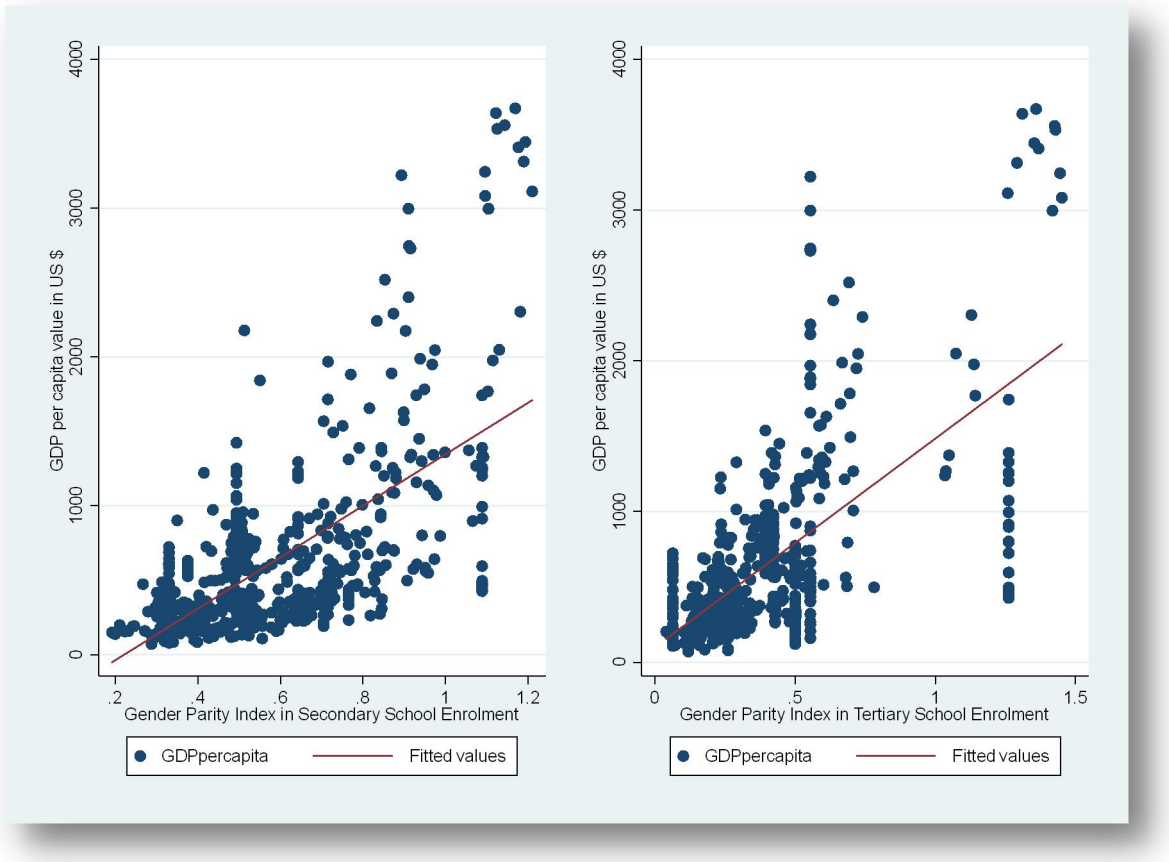


Source: The authors with World Development Indicators data

Capo Verde, Côte d'Ivoire, Nigeria, and Senegal have the relative highest GPD per capita among the sample. For these countries, gender parity states a different landscape. In Capo Verde, equality is favourable for women, although, in the others, inequalities are not favourable for women (annexe 1 and 2). The data show a positive relationship between gender parity indicators in education and GDP per capita for these countries.

Analysis of the relationship between GDP per capita and indicators of inequality in education reveals a positive relationship (Graph 3).

Graph 3: GDP per capita and gender parity index in education



Source: The author with WDI data

Reducing gender inequality in secondary and tertiary education increases GDP per capita. The correlation coefficients confirm this intuition of a positive relationship between GDP per capita and gender parity indicators in both secondary and tertiary education (Table 3).

Table 3: Correlation matrix between the variables

Variables	GDP per capita (Current US $)	Gender Parity Index in Secondary School Enrolment	Gender Parity Index in Tertiary School Enrolment
GDP per capita (Current US $)	1.0000		
Gender Parity Index in Secondary School Enrolment	0.6372*	1.0000	
Gender Parity Index in Tertiary School Enrolment	0.6789*	0.7910*	1.0000

*Significant at 5% level

Source: The author

The correlation coefficients are positive and significant at the 5% level. The empirical analysis in the following section will examine the existence of this causal relationship between gender parity indicators in education and GDP per capita.

4.2. Empirical results

Empirical results stand in two points. First, we estimate the interaction with the total factor productivity. Then, we set the complete model with both effect on total factor productivity and a bonus or a malus on labour force contribution. All variables in the log are stationary (annexe 3). The *Hausman* test indicates that the panel random effect is better (annexe 4). The use of random effects makes it possible to consider the unobserved heterogeneity in the panel. The Hausman test confirms our choice of the random-effects model.

The application of *generalised least squares* allows for autocorrelation and heteroscedasticity of the error terms.

4.2.1. Gender parity effect on the total factor productivity

Considering only the effect of gender inequality on total factor productivity. Equation 2 becomes

$$Y_{it} = A_0 \ \ GPI_{it}^{w_1} \ \ GPI_{it}^{w_2} \ L_{it}^{\alpha} \ K_{it}^{\beta} \qquad \textit{Equation 6}$$

So, we have

$$\tilde{y}_{it} = a_0 + w_1 \, gpi_{it} + w_2 \, gpi_{it} + \alpha l_{it} + \beta \, k_{it} \qquad \textit{Equation 7}$$

Finally, the equation is:

$$\tilde{y}_{it} = a_0 + w_1 \, gpi_{it} + w_2 \, gpi_{it} + \alpha l_{it} + \beta \, k_{it} + \vartheta \, Z_{it} + \varepsilon_{it} \qquad \textit{Equation 8}$$

Table 4 gives estimation results.

Table 4: Estimation results (equation 8)

Dependent variable: GDP per capita (current US$): Panel GLS Random-Effects	
Indépendantes variables	
Ln (Gross capital formation (% of GDP))	-0.01
	(0.83)
Ln(Population ages 15-64 (% of total))	2.61***
	(0.00)
Ln (GPI Tertiary School)	0.43***
	(0.00)
Ln (GPI Secondary School)	0.87***
	(0.00)
Control variable : GDP deflator	-0.00
	(0.30)
Constant	-3.09*
	(0.09)
Observations	611
theta	0.778
rho	0.291
sigma	0.520
sigma_e	0.438
sigma_u	0.280
chi2	352.4

pval in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: The author

As we can see, gender inequality in secondary and tertiary schools positively affects GDP per capita. We notice that reducing gender inequality in secondary school seems to have a more significant effect on GDP per capita than gender inequality in tertiary school.

Estimations results in table 5, (Result 2) and (Result 5) confirm these results. Without considering an eventual bonus due to the decrease in gender parity inequality, improving

gross female enrolment in secondary school provides, all other things remain equal, much more GDP per capita than reducing inequality in tertiary school enrolment. Indeed, gender inequality in education reduces GPD per capita.

4.2.2. Results of the complete model

Table 5 presents the results of the estimations. We consider estimate (6) with the GPI in tertiary school as the bonus/malus coefficient is significant at 5% level, and the increase in total factor productivity is also substantial.

Gender parity index in tertiary school enrolment positively impacts GDP per capita, leading to greater total factor productivity and a bonus. This result aligns with Licumba, Dzator, & Zhang (2015). The evidence presented in their paper suggests 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 and raise education quality, stimulate economic growth and advance other valuable development goals.

In this analysis, we draw essential attention to tertiary school enrolment. Indeed, a 1% increase in GPI in tertiary school induces a +0.39% increase in GDP per capita in the sample with a bonus of about +0.34%. At least, reducing gender inequality in tertiary education could increase GDP per capita by about +0.73%.

Table 5: Estimation results

Endogenous variable: GDP per capita (current US$): Panel GLS Random-Effects						
Exogenous variables	(Result 1)	(Result 2)	(Result 3)	(Result 4)	(Result 5)	(Result 6)
Ln (Gross capital formation (% of GDP))	0.15***	0.04	-0.00	0.15***	0.01	-0.00
	(0.01)	(0.35)	(0.94)	(0.01)	(0.84)	(0.96)
Ln(Population ages 15-64 (% of total))	3.64***	2.88***	1.77***	3.64***	2.84***	2.06***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln (GPI Secondary School)		**1.24*** **	**-0.14**			
		(0.00)	(0.70)			
GPI Secondary School*Ln(Pop ages 15-64 (% of total))			**0.64*** **			
			(0.00)			
Control variable : GDP deflator	-0.00**	-0.00	-0.00	-0.00**	-0.00	-0.00
	(0.01)	(0.18)	(0.37)	(0.01)	(0.14)	(0.10)
Ln (GPI Tertiary School)					**0.73*** **	**0.33*** **
					(0.00)	(0.01)
GPI Tertiary School*Ln(Pop ages 15-64 (% of total))						**0.34*** **
						(0.00)
Constant	-8.61***	-4.58**	-2.39	-8.61***	-4.22**	-2.08
	(0.00)	(0.02)	(0.22)	(0.00)	(0.03)	(0.30)

Observations	611	611	611	611	611	611
theta	0.820	0.805	0.817	0.820	0.748	0.758
rho	0.389	0.351	0.381	0.389	0.238	0.256
sigma	0.665	0.563	0.570	0.665	0.533	0.531
sigma_e	0.520	0.453	0.448	0.520	0.466	0.458
sigma_u	0.415	0.333	0.351	0.415	0.260	0.268
chi2	63.48	283.0	302.8	63.48	253.0	268.7

pval in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: The author

Seeking gender equality in tertiary education will increase the average GPI index from 0.3993 to 1. This result corresponds to a variation of 150%. The effort to be made is of the order of more than double the current average situation. Thus, all other things being equal, the GDP per capita growth will increase by 0.6%.

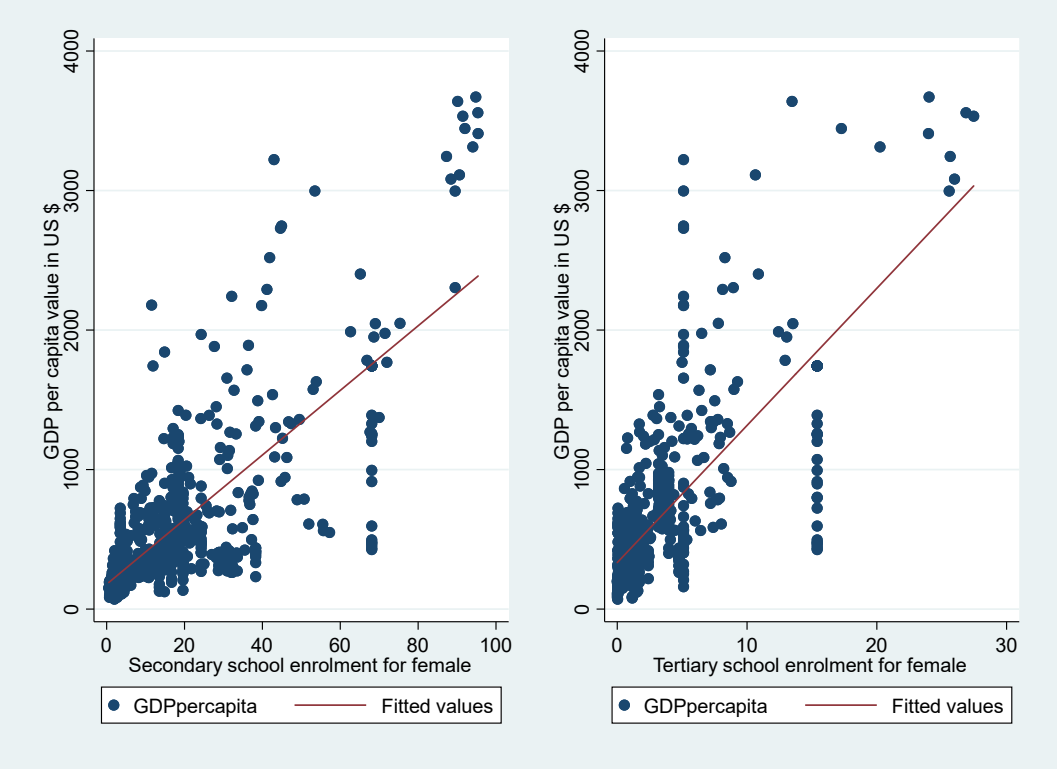
4.2.3. Robustness check

To perform the robustness check, we could use another data set measuring parity in education to check to what extent the effects obtained are independent of the data, but the results reflect a robust relationship. In the absence of an alternative data source and measure of gender parity in secondary and tertiary education, we re-estimated the proposed models with gross enrolment rates for girls. This choice is justified because all the countries in the sample over the period have a ratio of less than 1. In this case, any policy to reduce inequalities will consist of implementing actions to bring the parity indicator towards 1. This situation implies that the enrolment rate of girls should increase sufficiently to equal that of boys in both secondary and higher education.

Therefore, the intuition is to validate the fact that reducing gender inequalities in secondary and university education is directly equivalent to increasing the enrolment rate of girls relative to that of boys. As presented in the results above, the measured effects of these rates on GDP per capita should also be positive. In terms of approach, we proceed in two steps. The first step is to redraw the graphs crossing these indicators with GDP per capita. The second step repeats the estimates by considering these new variables of interest. The results should corroborate those obtained previously

The following graph (graph 4) shows the relationship between the sample's enrolment rate and GDP per capita. As can be seen, higher values of enrolment rates for girls in both secondary and tertiary education are associated with higher values of GDP per capita in the sample over the period. Thus, it could be said that increasing girls' enrolment rates, all other things being equal, could lead to an increase in GDP per capita on average in West Africa. This intuition has already appeared in the descriptive analysis of the relationship between GDP per capita and the gender parity indicators in education.

Graph 4: GDP per capita and gross school enrolment in secondary and tertiary school for female



Source: Author with World Development Indicators data.

The following table (table 6) presents estimation results of the effects of enrolment rates on GDP per capita.

As we can see, the relationships highlighted between the reduction of inequalities in education and GDP per capita are confirmed by the estimation results in Table 6. These results demonstrate that pursuing gender parity in schooling improves GDP per capita on average in the sample of countries considered.

Table 6: Robustness check estimations results

Endogenous variable: GDP per capita (current US$): Panel GLS Random-Effects								
Exogenous variables	(Result 1)	(Result 2)	(Result 3)	(Result 4)	(Result 5)	(Result 6)	(Result 7)	(Result 8)
Ln (Gross capital formation (% of GDP))	0.01	0.02	0.00	0.01	0.04	0.02	0.03	0.01
	(0.76)	(0.59)	(0.91)	(0.73)	(0.36)	(0.66)	(0.46)	(0.86)
Ln(Population ages 15-64 (% of total))	**3.28*** **	**3.19*** **	**2.08*** **	**1.99*** **	**2.89*** **	**2.30*** **	**2.16*** **	**2.95*** **
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(Secondary School enrolment rate, female)	**0.48*** **	**0.48*** **	**0.33*** **	**0.33*** **				**0.38*** **
	(0.00)	(0.00)	(0.00)	(0.00)				(0.00)
Control variable : GDP deflator		-0.00		-0.00	-0.00		-0.00*	-0.00
		(0.19)		(0.21)	(0.10)		(0.08)	(0.21)
Ln(Secondary School enrolment rate, female)*Ln(Pop ages 15-64 (% of total))			**0.00*** **	**0.00*** **				
			(0.00)	(0.00)				
Ln(Tertiary School enrolment rate, female)					**0.27*** **	**0.23*** **	**0.22*** **	**0.11*** **
					(0.00)	(0.00)	(0.00)	(0.00)
Ln(Tertiary School enrolment rate, female)*Ln(Pop ages 15-64 (% of total))						**0.01*** **	**0.01*** **	
						(0.00)	(0.00)	
Constant	-8.09***	-7.71***	-3.16	-2.83	-5.42***	-3.11	-2.57	-6.48***
	(0.00)	(0.00)	(0.13)	(0.18)	(0.00)	(0.14)	(0.22)	(0.00)

Observations	611	611	611	611	611	611	611	611
theta	0.815	0.814	0.828	0.828	0.737	0.725	0.727	0.758
rho	0.375	0.374	0.410	0.411	0.222	0.207	0.209	0.256
sigma	0.533	0.532	0.541	0.542	0.521	0.514	0.514	0.480
sigma_e	0.421	0.421	0.416	0.416	0.459	0.458	0.457	0.414
sigma_u	0.326	0.325	0.347	0.347	0.246	0.234	0.235	0.242
chi2	424.6	426.9	449.5	451.4	288.6	301.0	304.5	479.9

pval in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: The author

Ultimately, the results obtained are robust. So, seeking gender parity in education in West Africa will increase on average GDP per capita.

5. Conclusion and policy implications

This paper fills a gap in assessing the effect of gender inequality in education on GDP per capita in a panel of thirteen west African countries. Data run from 1971 to 2016. We consider two stages of education, secondary and tertiary. We suppose that people can work according to the minimum age and skill developed after training (both general and professional training). We also consider heterogeneity among countries and possible autocorrelation and heteroscedasticity of error terms in estimation by using a random effect panel. Results reveal substantial inequality in education among countries at both levels of education. This inequality is favourable to boys as the average level of the gender parity index is lower than one. Only Capo Verde records a different situation in education. In this country, inequality is favourable to females.

Then we show that reducing gender inequality at both stages of education positively affects GDP per capita on average. When we assume a potential bonus from reducing this gender inequality, it appears that that reducing gender inequality in tertiary school enrolment positively affects GDP per capita with a bonus.

So, following Licumba, Dzator, & Zhang (2015), this paper supports advocation about policy adjustment in west Africa in education at secondary and tertiary school enrolment. Improving gender parity index in secondary and tertiary schools stimulates GDP per capita. Seeking gender parity in education leads to an increased GDP per capita.

These results motivate policies to reduce gender inequalities by increasing females' secondary school enrolment rate (% gross). This policy will contribute to improving the income per capita. Indeed, the study recommends:

- Strengthen the secondary education system in the sub-region to ensure the quality of training and promote girls' skills.
- Support member states in improving the gross enrolment rate of girls in secondary school. Indeed, member countries are not the same time as the development of the secondary education system. Targeting Burkina Faso, Guinea Bissau, and Niger would be interesting.

ECOWAS commission could develop and implement specific support policies for these countries.

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

References

[1] Andrew, M., Dhushyanth, R., & Nistha, S. (2007, September). Gender equality, poverty and economic growth. *Banque Mondiale, policy research working paper*(4349).

[2] Baliamoune-Lutz, M. &. (2007). Gender inequality and growth in Sub-Saharan Africa and the Arab countries. *African Development Review, 21*, 224-242.

[3] Baliamoune–Lutz, M., & McGillivray, M. (2015). The impact of gender inequality in education on income in Africa and the Middle East. *Economic Modelling, 47*, 1-11.

[4] Chaudhry, I. S., & Saeedur, R. (2009). An empirical analysis is the impact of gender inequality in education on rural poverty in Pakistan. *European Journal of Economics, Finance and Administrative Sciences, 15*(1), 174-188.

[5] Chaudhry, I. S., & Saeedur, R. (2009). An empirical analysis is the impact of gender inequality in education on rural poverty in Pakistan. *European Journal of Economics, Finance and Administrative Sciences, 15*(1), 174-188.

[6] Cuberes, D., & Teignier, M. (2011). *Gender inequality and economic growth.* Washington: WORLD DEVELOPMENT REPORT 2012. Consulté le Avril 26, 2018

[7] Hallum, C., & Obeng, K. W. (2019). *La crise des inégalités en Afrique de l'ouest, quelles sont les solutions face à l'échec des pays d'Afrique de l'ouest à réduire les inégalités ?* Oxford: Oxfam International. doi:10.21201/2019.4511

[8] HILL, M. A., & Elizabeth, M. K. (1995). Women's education and economic well-being. *Feminist Economics, 1*(2).

[9] Klasen, S. (2002). Low schooling for girls, slower growth for all? Cross-country evidence on the effect of gender inequality in education on economic development. *The World Bank Economic Review, 16*(3), 345-373.

[10] Klasen, S. (2017). Gender, institutions, and economic development. *Courant Research Center Discussion Paper*.

[11] Klasen, S. (2018). The impact of gender inequality on economic performance in developing countries. *Annual Review of Resource Economics, 10*, 279-298.

[12] Knowles, S., Paula, K. L., & Dorian, P. O. (2002). Are educational gender gaps a brake on economic development? Some cross-country empirical evidence. *Oxford Economic Papers, 54*.

[13] Licumba, E. A., Dzator, J., & Zhang, J. X. (2015). Gender equality in education and economic growth in selected Southern African countries. *The Journal of Developing Areas, 49*(6), 349-360.

[14] Mark, B., Sudharshan, C., Stephan, K., & David, L. (2007). Gender and growth in Sub-Saharan Africa: Issues and evidence. In Advancing Development. *In Advancing Development*, 349-370.

[15] Oriana, B., & Ashwini, N. (2013, February). Does Gender Inequality Hinder Development and Economic Growth? Evidence and Policy Implications. *The World Bank Research Observer, 28*(1), 2–21.

[16] SCHULTZ, T. P. (2002). Why governments should invest more to educate girls. *World Development, 30*(2).

[17] Seguino, S., & Were, M. (2014). Gender, development and economic growth in Sub-Saharan Africa. *Journal of African Economies, 23(suppl_1)*, i18-i61.

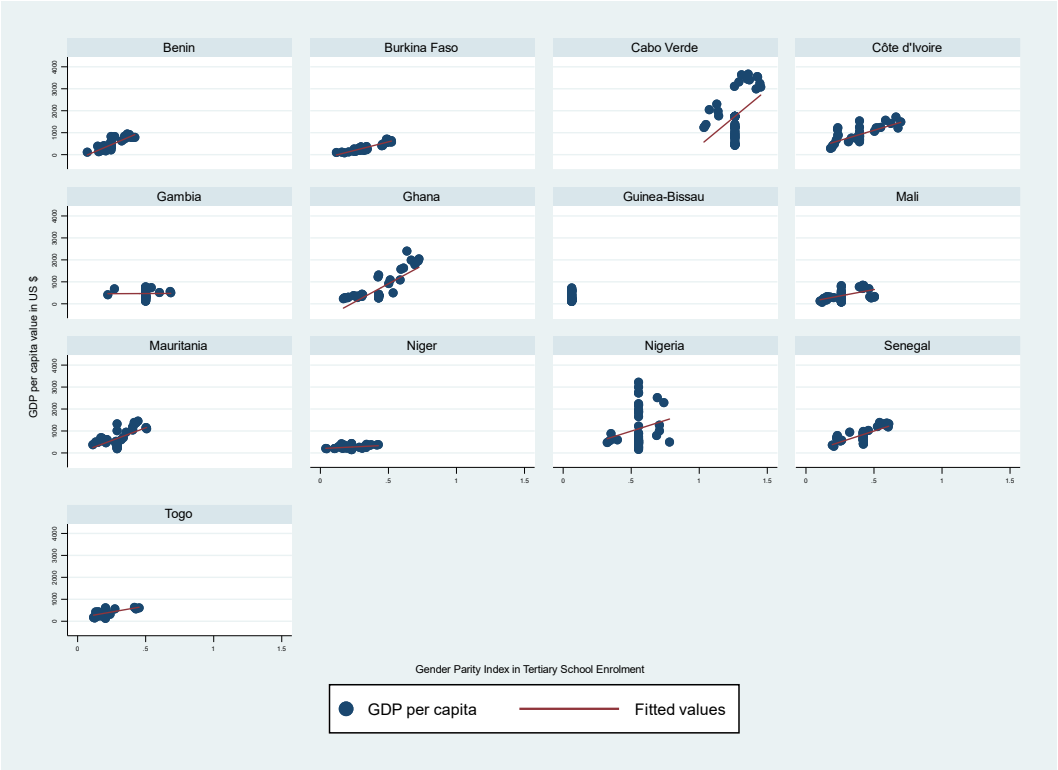
[18] World Bank. (2011). *World development report 2012: gender equality and development: Main report (English).* Washington, DC: World Bank Group.

Appendix

Annexe 1 GDP per capita and gender parity index in secondary school Enrolment by country

Source: The author with World development indicators data

Annexe 2 GDP per capita and gender parity index in tertiary school Enrolment by country



Annexe 3 Results of panel unit root tests

Variables	Level	
	Im-Pesaran-Shin unit-root test	ADF-Fisher unit-root test
Ln(GDP per capita in currents US $)	-3.2156*** (0.00)	-1.5252* (0.06)
Ln (Gross Capital formation % GDP)	-6.4749*** (0.00)	-4.0887*** (0.00)
Ln(Population ages 15-64 (% of total))	-1.5035* (0.066)	-5.0705*** (0.00)
Ln (GPI Secondary School)	-8.5911*** (0.00)	-8.4728*** (0.00)
Ln (GPI Tertiary School)	-7.2192*** (0.00)	-8.9808*** (0.00)
Ln(Secondary School enrolment, female)	-6.6231*** (0.00)	-7.9173*** (0.00)
Ln(Tertiary School enrolment, female)	-7.1567*** (0.00)	-8.8534*** (0.00)
GPI Secondary School*Ln(Pop ages 15-64 (% of total))	-6.7489*** (0.00)	-8.0351*** (0.00)
GPI Tertiary School*Ln(Pop ages 15-64 (% of total))	-6.5611*** (0.00)	-8.1017*** (0.00)

Adjusted Statistic t* and (p-value)

Source: The author

Annexe 4

```
Fixed-effects (within) regression               Number of obs     =         611
Group variable: id                              Number of groups  =          13
R-sq:                                           Obs per group:
     within  = 0.2918                                         min =          47
     between = 0.6820                                         avg =        47.0
     overall = 0.4593                                         max =          47
                                                F(4,594)          =       61.17
corr(u_i, Xb)  = -0.6598                        Prob > F          =      0.0000

------------------------------------------------------------------------------
        lgdp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        lgcf |      -0.02       0.05   -0.495   0.621        -0.12        0.07
        lpop |       1.49       0.56    2.663   0.008         0.39        2.60
      lgpits |       0.16       0.16    1.024   0.306        -0.15        0.46
  GPItslnpop |       0.57       0.13    4.379   0.000         0.31        0.82
       _cons |      -0.36       2.08   -0.175   0.861        -4.45        3.72
-------------+----------------------------------------------------------------
     sigma_u |       0.43
     sigma_e |       0.43
         rho |       0.47   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(12, 594) = 17.36                     Prob > F = 0.0000

. estimate store fixed
Random-effects GLS regression                   Number of obs     =         611
Group variable: id                              Number of groups  =          13
R-sq:                                           Obs per group:
     within  = 0.2884                                         min =          47
     between = 0.7156                                         avg =        47.0
     overall = 0.4831                                         max =          47
                                                Wald chi2(4)      =      263.14
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =      0.0000

------------------------------------------------------------------------------
        lgdp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
        lgcf |      -0.02       0.05   -0.372   0.710        -0.11        0.08
        lpop |       2.14       0.52    4.096   0.000         1.12        3.17
      lgpits |       0.33       0.13    2.629   0.009         0.08        0.58
  GPItslnpop |       0.35       0.10    3.592   0.000         0.16        0.54
       _cons |      -2.41       2.00   -1.206   0.228        -6.32        1.51
-------------+----------------------------------------------------------------
     sigma_u |       0.29
     sigma_e |       0.46
         rho |       0.28   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. Hausman fixed . , sigmamore

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed          .          Difference          S.E.
-------------+----------------------------------------------------------------
        lgcf |   -.0237028    -.0177321       -.0059706          .00713
        lpop |     1.49389     2.144452       -.6505622         .210856
      lgpits |    .1590391     .3338982        -.174859        .0909293
  GPItslnpop |     .566423     .3507551        .2156679        .0860195
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg
    Test:  Ho:  difference in coefficients not systematic
                  chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       11.40
                Prob>chi2 =      0.0224
```