EDUCATION INEQUALITY IN WEST AFRICAN COUNTRIES: DOES INVESTMENT IN EDUCATION MATTER?

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ABSTRACT

The paper examines whether education investment has an impact on the high quantity of education inequality in the West African (WA) countries. The paper considers inflation as a constraint to government capability to invest in education. In consequence, the study used a balanced panel data of twelve countries where education inequality is the dependent variable, and that education index serves as a proxy for education inequality since it is a measure of disparity regarding human development. The research used panel time series data from Human Development Indicators and World Bank databases, with panel data analytical techniques. The data have 16 data points that covered 1999 to 2014 with a total sample size of 192. With the presence of missing completely at random (MCAR) of the data, expectation maximisation (EM) technique was employed to replace the missing values. Although existing official data indicated that the governments of the WA countries invested 4.58% of the gross domestic product (GDP) of public expenditure that goes to education sector, which is higher than OECD countries, this research results indicate that the cumulative public expenditure that goes to education significantly increases the volume of education inequality in the WA countries. Therefore, the study concludes that amount invested seems insufficient to reduce education inequality for the countries to catch-up with the desired skill, knowledge and growth. So, the researchers propose and suggest UNESCO to have a higher rate of education expenditure as a ratio of GDP for education financing should be strictly followed in the annual government budgeting. The researchers further suggest that the region is expected to consistently develop a five-year expenditure rolling plan (ERP) on education to increase human capital stock leading to a knowledge-based economy.

Keywords: Education Inequality, Education Investment, Out-of-School, Investment Creativity, Educational Attainment, West African Countries.

INTRODUCTION

Since the 2000 millennium development goals (MDGs), covering the gap of unequal education has been an economic debate among the technocrats and academic community (Bakar & Tuah, 2006; Pan, 2014). Education inequality manipulates the quality of country human capital stock with effect on living standard, growth and productivity (Krueger & Lindahl, 2001; Miyagishima, 2016). The notable aspect of the human capital stock lies on the promise of moving up the developing countries' technological hierarchy with attempt to diversify the economy (Acemoglu & Angrist, 1999; Yusuf, Saint, & Nabeshima, 2009). With this conscious effort of knowledge and diversification, investment in human capital, like the physical capital, becomes an intrinsic economic value for national development. As such, education investment becomes more visible both at public and private domains to reduce the spread of inequalities of education (Mariana, 2015; Pan, 2014).

The truth underlying investment in education is the labour market demand such that differences in educational attainment (knowledge, skill and training) across households and countries (Acemoglu, 1999), should encourage adequate funding of education at all levels (Bakar & Tuah, 2006). No doubt, the difference in the educational attainment usually confines individual household to low status and low wages as well as high status and high wages (Miyagishima, 2016). In that case, both government and individual household should be enthusiastic towards education investment due to the public and private returns to education (Mariana, 2015; Psacharopoulos & Patrinos, 2004). However, despite social and private returns from investment in education, recent studies indicate that most developing countries face challenges of inequality of education, which appears as an impediment to human welfare and growth (Bakar & Tuah, 2006; Thomas, Wang, & Fan, 2001).

The quantity of education inequality for the West African countries is explained in the Human Development Report (HDR, 2015). For example, the education index parameter for development which classifies education inequalities and defines the status of country development have ranked Togo, Niger, Nigeria, Mali, Gambia and Cote d'Ivoire as the 166, 187, 152, 176, 172 and 171 out of 195 countries respectively. With this ranking, it is argued that not only that physical capital is essential for growth, but a significant investment in education also points to growth and productivity through balancing of education distribution (Yusuf et al., 2009). It connotes that investment in physical and human capital (i.e. education) complements each other. The investment in education as a tonic to inequality of education (Gruber & Kosack, 2014) is captured by government spending that goes to education. In universality, the expectation of education investment is that a higher percentage of public spending that goes to education, expressed as a ratio of gross domestic product (GDP), explains the volume of the national economy and the extent of reduction in education inequality (UNESCO, 2018).

Education inequality arises from differences in schooling completion. Within the grade transition, a number of school-age children dropped out from schooling. Since the state of out-of-school is a measure of inequality in education distribution (Gamoran, 2015), the out-of-school issue could arise from inadequate education funding and unaffordability such as the upward rise of schooling fee (Hendel, Shapiro, & Willen, 2005). Table 1 provides information about twelve countries of West Africa indicating the out-of-school and government expenditure that goes to education in two periods.

Table 1
Out-of-School Children and Government Education Expenditure

Country	Out-of-school children		Government expenditure on education /% of GDP		Government expenditure on education /% of GDP	
	Rate	Year	Percentage	Year	Percentage	Year
Benin	4	2014	3	2000	4	2014
Cote D'Ivoire	12	2016	4	2000	5	2014
Cape Verde	14	2016	7	2002	5	2017
Gambia	21	2017	2	2000	3	2013
Ghana	15	2017	5	2001	6	2013
Guinea	20	2014	3	2000	4	2014
Mali	38	2016	3	2000	4	2013
Mauritania	29	2016	3	2001	3	2014
Niger	36	2016	3	2000	7	2014
Sierra Leone	1	2016	5	2000	3	2014
Senegal	28	2016	3	2000	6	2010
Togo	13	2016	5	2000	5	2014

Note: The available data on Out-of-school children were collected from UNESCO (2018) and Government expenditure on education (total per % of GDP) data were obtained from World Bank (2016). The data were rounded to the nearest whole number.

On the one hand, the administrative data (see Table 1) on out-of-school children indicates that besides Benin with 4% and Sierra Leone with 1%, other countries vary considerably ranging from 12% of out-of-school to as high as 36% in Niger and 38% in Mali. According to Gamoran (2015), students from low-income families do abandon school earlier with the consequence of receiving lower certificates and degree compared with their privileged peers. As such, the level of inequality in education distribution is increased by a high number of out-of-school. On the contrary, the cursory look at government investment in education is vital for education growth and concern for welfare. Hence, all the selected West African countries (see Table 1) invested a considerable amount of their national income to education. In average, the twelve countries spent 4.58% of their GDP on education that includes capital, current and transfers. If compared with OECD countries having an average of 4.5% in 2013 estimation (OECD, 2016), the government attitude of the twelve countries demonstrates that education was made a priority. Nevertheless, the government expenditure does differ across the twelve West African countries ranging from as low as 3% of GDP in Gambia, Mauritania and Sierra Leone to as high as 7% of GDP in Niger, 6% of GDP in Ghana and Senegal in 2013 and 2010 respectively. From this scenario, a paradox exists in comparing the attitude of government on public spending that goes to education and the substantial number of out-of-school. For example, though Niger government increased expenditure from 3% of GDP in 2000 to 7% of GDP in 2014, Niger had 36% of out-of-school in 2016 and ranked 187 in human development index of 2013.

Similarly, Mali with 1% change in the education expenditure in 2013 was found with 38% out-of-school. Another paradox was Sierra Leone whose out-of-school was 1%, but there was a reduction in government expenditure from 5% of GDP in 2000 to 3% of GDP in 2014. This paradox raises a question – does government expenditure on education matter in education distribution?

Over the years, studies on education investment in relation with economic growth and economic volatility (Flug, Spilimbergo, & Wachtenheim, 1998; Jorgenson & Fraumeni, 1992; Mariana, 2015), investment in human capital as regards the families, (Chi & Qian, 2016; Kalemli-Ozcan, Ryder, & Weil, 2000; Nelson & Phelps, 1966; Schultz, 1961; Wang & Yu, 2017) gained much attention. Others are returning to education investment as regard development, wages inequality and profitability of education (Phan & Coxhead, 2013; Psacharopoulos, 1981, 1994; Psacharopoulos & Patrinos, 2004; Psacharopoulos & Woodhall, 1985). In all, education was seen as an investment in human capital development (Jorgenson & Fraumeni, 1992; OECD, 2012). Investing in education or human capital captures opportunities in the increase of productivity and income; reduce poverty, climb the highest ladder of the hierarchy of needs and reduction in social inequality (Griffin & McClish, 2011; Maslow, 1943; OECD, 2012). As such, an individual's level of education attained helps to fix the status and allocate job available for them. The allocation provides the understanding that those with higher education are likely to be more productive than low education or no education category (Jorgenson & Fraumeni, 1992; Mariana, 2015). Hence, Mariana (2015) argued that a given society cease to be functional with the absence of the minimum level of education due to multiplier advantages of education acquisition. Otherwise, the low education and wages have the purview to make an economy revolve around education inequality with severe economic hardship. Likewise, in the labour participation in politics, the enthusiasm for voting right lies on the individual level of income and the level of education individual occupies in education hierarchy (Jensen & Jespersen, 2017; Mariana, 2015).

Previous studies on investment in education had taken different approaches (Gruber & Kosack, 2014; Hendel et al., 2005). In the developing economies, the high dispersion of income and the depth of poverty were blamed on low education or education inequality (Wu, Zhang, & Zhang, 2008). However, we suspect that previous studies have not considered the impact of education investment on education inequality. In consequence, this study attempts to examine education investment and observe how it impacts on education inequality of the West African countries.

To address the research gap of this study, this paper explicitly attempts to (1) investigate the impact of government public expenditures on the educational inequality in the West African Countries and (2) examine the inflationary impact on the rising of education inequality of the West African countries. With the panel data analysis employed, our results show that there is a positive relationship between public investment in education and the unequal education during the period which is not suitable for human capital stock. The study has contributed to the existing literature about the effect of public expenditure on the rising of education inequality.

LITERATURE REVIEW

Theoretical Framework

In macroeconomic theory, output equals income either in the primitive economy or a complex type. In a two-sector economy (i.e. consumption and savings), not all income is consumed. As such, the proportion that is saved is often used to account for the payment of capital for further production. In that case, savings equal investment (González, 2014). This goes with the argument that the proportion of savings explains the volume of investment. To understand the equation, economically; the investment funding depends on consumption and investment (González, 2014). To achieve the desired investment in education requires a creative mentality. To this end, this study applies the investment theory of creativity (Sternberg, 2012). The Sternberg (2012) theory of investment creativity stipulates that an investor put in his resources (time and effort) into a venture with a high level of creativity to maximise the high level of output.

There are six resources applicable to investment theory of creativity as theorised by Sternberg, (2012) which comprises of knowledge, motivation and intellectual abilities. Others include styles of thinking, environment and personality. These resources in creativity are acquired, not only by the geniuses but from people of low intelligence. Amabile and Pillemer (2012, p. 4) argued that creativity arises from "special qualities of unusual persons". Though education acquired through four corners of a classroom could be challenging to low intelligent students, the application of creativity resources turns the poor qualities of the "unusual person" (as well poor economies) to a better person or better institution. However, projecting for a creative investment calls for a trait (Doračić, 2017). The fundamental of creativity is that an individual or institution require possessing a behaviour and capability that give the opportunity to solve problems, where the problems solved, are the products of creativity. The product is innovation. While that may be true, Amabile and Pillemer (2012) redirect the attention to skill where skill is learned and improved upon.

In the life cycle model, Heckman and Mosso (2014) positioned that skill is multidimensional and that it comprises of four indicators. The skill dimensions are the child personality, cognitive, health and preference which enhances the child capabilities to act and enhances investment in human development. As such, a well-developed skill validates future expectations, promotes knowledge and shapes constraints which in turn gives freedom to the individual to participate in the economic resources sharing (Heckman & Mosso, 2014; Sen, 1999). In developing countries where diversification is most required, the education investment, in any way, should have the focus on a skill that depends on cognitive and non-cognitive skills as well as the child health (Heckman & Mosso, 2014; Todaro & Smith, 2012). To that end, the skill is modelled in Heckman and Mosso (2014) as stated in equation (2.1);

$$S_t = (S_{c,t}, S_{nc,t}, S_{h,t})$$
$$t = 1,..,T,$$ (2.1)

The S represents the skill at time *t*, *c* is the child cognitive, *nc* is the child non-cognitive domain while the h represents the child health stock that comprises of physical and mental at specific age *t*. Another thing to be noted in the equation (2.1) is that the vectors depend on age to a given outcome (Heckman & Mosso, 2014). This is to argue that an old skill could be maintained where necessary. However, due to changes in economic demands for technology and welfare, the old skill may forget to give way for a new skill yielding a new product (Sternberg, 2012). In other words, there is a need for continuous investment in education to increase knowledge in a multiple of skills.

As per knowledge, creatively, knowledge produces innovation (Sternberg, 2012). According to (Sternberg, 2012), knowledge is in two ways, information about the past and the ability to change the past based on current environmental experiences. The individual or institution has the task, under the precarious condition, to make things new by managing the skill acquired over time. The process of buying the unknown, in other words, low capability either in money term or ideas, and sell the idea or product at high value despite opposition yields transformation from old to new. Knowledge is acquired in the established institutions, most of the developing countries have the qualities of the unusual person, that is, the possession of mineral resources to enhance creativity (Amabile & Pillemer, 2012; Sternberg, 2012). Hence, through adequate investment in knowledge, the cognisance of the significance of education in economic development enhances the minimisation of education inequality which defines the quality of the unusual person (Sternberg, 2012). In macro approach, investment in education includes government's vision to fully improve public expenditure on education annually (Santelli, Song, Garbers, Sharma, & Viner, 2017).

The Investment Constraints

As pointed out by (Sternberg, 2012) and Heckman and Mosso (2014), inflation is the number one public enemy in public spending (Oner, 2010). In other words, the public spending could be affected by this market enemy called inflation. Hence, the performance of the economy and human development management depends on the purchasing power of the currency available to the government about the gross national product (GNP). Therefore, inflation represents the proportional increase in prices over a given period. It is a measure of the total increase in prices or simply put an increase in the national cost of living (Oner, 2010). As such, the persistent rising in prices is a constraint towards public and private spending in education. The outcome of the spending reflects on the quantity of human stock in the country. Not only that, educational attainment would be unequally distributed due to high prices of goods and services that affect household and government, (Ranis, Stewart, & Ramirez, 2000) assumption of chain B, which defines human development enhances the gross national product, does breaks down. This is because additional schooling, which defines the increase in human development, simultaneously increases economic growth (Krueger & Lindahl, 2001; Todaro & Smith, 2012). The position, therefore, is that the difference that exist in education distribution is a constraint with the persistent rising of market prices which influences the allocation of public funds to education as well as private resources share to family education. In other words, government public spending on education depends on the realisation from GDP control by inflation.

As Sternberg (2012) concluded, creativity is achieved with several resistances or as referred to in Heckman and Mosso (2014) skill model as constraints. As such, the government's intention to invest in education to control education inequality usually encounters resistance such as inflation as a result of the adjustment through an increase in interest rate on sensitive goods (public good as well) (Labonte, 2011). Bridging the inequality of education gap by increasing the national skill capacity regarding investment in education depends on the expenditure on education (public and household) and the constraints (inflation) to investment in education which affect the government GNP and household income (Oner, 2010; Ranis et al., 2000). Experience through administrative data shows that the budgeting for education expenditure has over time being flexible in most of the developing countries due to different shocks of government revenue, in some cases, resulting in hyperinflation. The effect ranges from the shortfall in government creative capability to invest in knowledge to the reduction of cost of human capital development and creates education disparity between the haves and the have-nots (Jensen & Jespersen, 2017). The experience of OECD countries opens the understanding of the commitment of investing a significant proportion of their national income to education between 2001 and 2008. For example, when the OECD countries combined expenditure on education, 61% goes to the three levels of education (OECD, 2012). This is attributed to creative and skill capability in recognising lifelong learning in human development as reflected in the life cycle model (Heckman & Mosso, 2014; Sternberg, 2012; Sternberg & Lubart, 1991).

Theoretical Framework

The idea of human capital development is presented as a theoretical framework in Figure1. The theoretical proposition of human capital development (HCD) is captured by three variables as derived in the work of Blundell, Dearden, Meghir, and Sianesi (1999) and Heckman and Mosso (2014). The HCD indicators are earlier ability, certificate obtained and skill acquired.
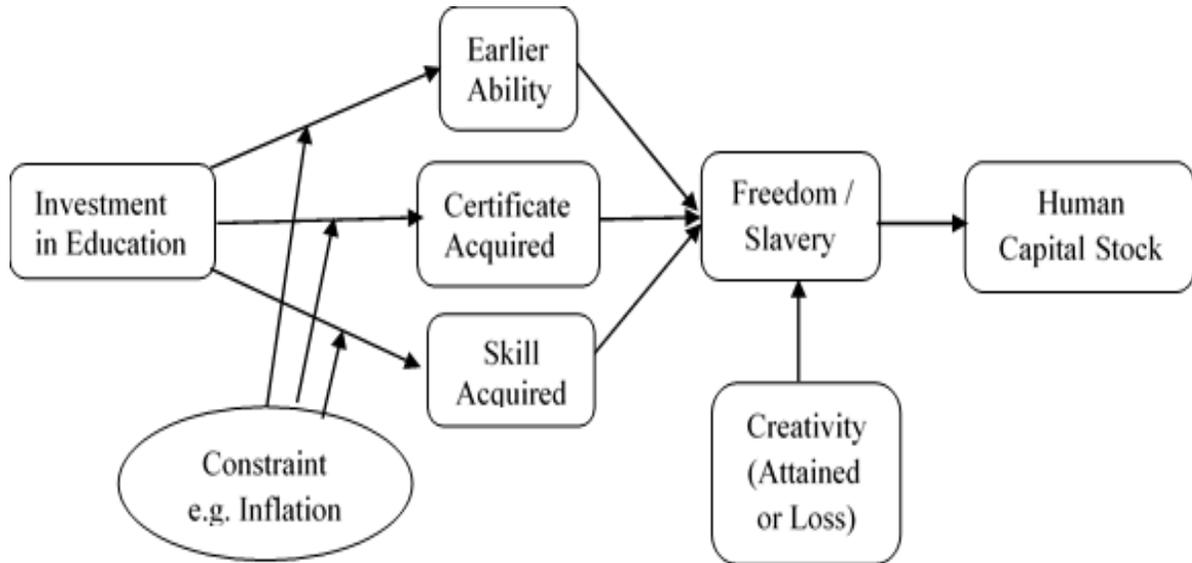
Figure 1. The Flow of Education Investment and Human Capital Stock

The framework in Figure 1 summarises the works reviewed in this paper. The framework is understood as a process to which investment to attain a specific human capital stock (earlier acquired, certificate and skill) either by the government or household is constrained by an economic indicator such as inflation such that creativity (innovation) is attained or loss. In other words, inequality in education in the three domains which gives freedom to the owner depends on the volume of investment in education and is controlled by persistent rising in the market product prices (inflation).

Empirical Literature

Scores of literature considered education investment about the economic growth benefits (Blundell et al., 1999; Krueger & Lindahl, 2001; Santelli et al., 2017). For example, relating the adolescent birth rates (ABR) with education expenditure and economic growth, Santelli et al. (2017) applies the multivariate analysis of generalised estimating equations to analyse the effect of education expenditure, inequality in income and per capita gross domestic product (GDP) on the adolescent birth rate. Education investment through public spending was found negatively related to ABR. Hence, investment in education discourages early childbearing. Whereas, Blundell et al. (1999) and Krueger and Lindahl (2001) showed that investment in human capital or increase in the stock of education acquired increase economic growth. In Herrington (2015), taxes and education expenditure were used to compare the United States and Norway pattern of financing education and its impact on income inequality. Findings indicate that the labour taxes and education spending accounted for one-third of income inequality between the two countries (Herrington, 2015).

Investment in education has diversities. One of them is a subsidy, as it was studied in Bakar & Tuah, (2006). The incorporation of subsidy in their analysis was earlier discussed by Ram (1982) that fund invested into the upper level of education (tertiary), does not only contributes to the education inequality but the primary and secondary levels subsidy is equally reliable to understand education inequality. Hence, the outcome of the Gini analysis showed that fund invested into education subsidy adversely affect unequal education. Another is on investment on the wage inequality regarding the skill and the unskilled workers (Pan, 2014). In this case, findings showed that, although it is rear as well as under certain condition would an increase in education capital kindles production in the manufacturing sector (Pan, 2014), however, a unit increase in capital investment in the education sector

usually transform the economy. In the research by Mariana (2015), it was revealed that with higher levels of education, public returns to education has less value to the private returns to education if more fund goes to the education sector. The study concludes that the increase in scientific knowledge and technology raises the challenge to boost the knowledge economy through a considerate proportion education expenditure that goes to education.

Likewise, in Psacharopoulos (1985), the outcome of the study on the rate of return for investing into educations showed that in the developing countries, there existed underinvestment, especially at the primary school level which is caused for the demand for education (Nomura, 2011). Although the growth of the region was suitable during the period understudy, the investment in education constraints would persist as demand keeps on increasing (Nomura, 2011). It is not equally a hidden issue that skill from education is the driver for growth. In that case, Saint (2015) suggests that huge investment in education especially at the tertiary level to build the human capital for growth and productivity would require adequate funding. Although some countries in the sub-Sahara Africa have good ratio of expenditure to gross domestic product (Nomura & Bruneforth, 2011; Majgaard & Mingat, 2012), we cannot underscore the fact that increasing of enrolment in African countries arising from international pressure for advancing equal education is a push factor towards having "expenditure per student" driven down "and placed quality at risk" (Saint, 2015, p.15).

This current study suspect from the literature reviewed that, though the effect of poor investment in education is achieved in those studies relating to growth, subsidy and others; it is not clear whether the investment in public education expenditure impacts on the reduction of education inequality. Hence, this study assumes that public expenditure on education does not significantly impact on education inequality in the West African countries.

METHOD

Research Design

This paper is quantitatively designed which employs secondary source and panel time series data to determine the impact of public education investment and inflation on the quantity of education inequality over time in the West African countries. Since the study does not have the characteristics of primary sources of data, the procedure of time series analysis is followed.

Population and Sampling

The study scope covers the West African countries that comprise both Economic Community of West Africa Countries (ECOWAS) and non-ECOWAS countries. substantial number of the eighteen countries of West Africa have mineral resources but characterized with poor living standard.

Expectedly, the eighteen countries were designed to be included in the analysis. However, due to inadequate data on the study variables, the researchers employed purposive sampling technique to select 12 countries as a sample of the study (Kenya Inter-Agency Rapid Assessment, (KIRA, 2014; Tongco, 2007). The study is a secondary and time series data. Our intention was to collect secondary data to examine the relationships for ALL the 18 countries without taking sample. However, all the countries in West African countries are low education trapped. In consequence, the researchers purposefully used the 12 countries that had secondary data available for our model variables. Each of the panel contains 16 data points that covered 1999 to 2014 with a total sample size of 192. Hence, the purposeful sampling used in the study is a scientific method of sample selection which depends on what the researcher wants to achieve in the study (Palinkas et al., 2015; Palys, 2008).

Variables Definition

In this study, the researchers chose the model variables following the theoretical framework in Figure 1 in this paper. The proposition is that investment in education increases the human capital stock and growth. These include education inequality as a dependent variable proxy by education index, education investment measured by public spending on education and inflation which serve as a control variable to education investment.

Education Inequality

Conventionally, educational attainment explains the human capital stock overtime. Hence, inequality arises from the differences in educational attainment. In other words, educational inequality (EDINQ) is measured by educational attainment because differences in educational attainment account for the differential in earnings at the labour market (Mariana, 2015). Thus, we used the education index as a proxy for the EDINQ because, globally, education index is a measure of differences in education across countries (UNDP). Also, education index is computed with the principal variables of educational attainment (Thomas et al., 2001) which include the mean years of schooling (MYS) and the expected years of schooling (EYS). The MYS shows the mean value of completed years of education per country's population less the repeated grade level. This covers the population aged 25 and above. MYS is computed out of education attainment (UNESCO, 2013). The MYS is calculated using UNESCO model as stated in equation (3.1).

$$MYS = \sum_{\alpha} \sum_{l} HS_{\alpha l} * YS_{\alpha l} \qquad (3.1)$$

Where MYS = average years of schooling, HS = the proportion of the age group population α in which the education level l is the highest level completed and $YS_{\alpha l}$ is the official duration of education level l for age group α at the time when this age was in school (UNESCO, 2013).

Suppose the duration of each educational level is constant over time, the equation can further be simplified in equation (3.2) as:

$$MYS = \sum_{l} HS_{l} * YS_{l} \qquad (3.2)$$

The equation (3.2) provides a similar approach of Barro and Lee (2013) as explained in equation (3.3).

$$s_t^{\alpha} = \sum_{j} h_j^{\alpha}, t \, Dur_j^{\alpha}, t \qquad (3.3)$$

Where h_j^{α} represent the proportion of the group α with j educational level attained where j are all levels (primary, secondary and secondary) and Dur represents the years spent for the education level attained. Hence, either of the equations 3.2 or 3.3 could be used in estimating MYS because of similarity properties

Furthermore, the expected years of schooling (EYS) measures the number of years that a school child, at the beginning of his education process is expected to pass through. This is subject to making the current enrolment rate constant throughout the life of the child (UNESCO, 2009). The EYS takes into account the flow and stock of educational system (Thomas et al., 2001). Hence, it does not require standardisation where there are countries' age grouping differentials and computation comfortability (Rigotti, Sawyer, Souza, & Rodrigues, 2013). The conventional way of estimating the EYS by UNESCO is as shown in the following expressions in equation (3.4).

$$EYS_\alpha = \sum_\alpha^\omega n *_n m_x \qquad (3.4)$$

The $_n m_x$ is calculated in equation (3.5) as:

$$_n m_x = \frac{_n f_x}{_n P_x} \qquad (3.5)$$

Where α in equation (3.3) represents the age that the child begins schooling, ω represent the upper age limit, n represents that age interval. Also $_n f_x$ represents the number of pupils between ages x and $x+n$ given enrolment at year t; $_n P_x$ represents the population between the ages of x and $x+n$, at year t and $_n m_x$ is the rate of enrolment of pupils between the x and $x+n$ at year t. Hence, the $n *_n m_x$ stands as the cumulative time the set of pupils between the ages x and $x+n$ got enrolled with the assumption that all the pupils were in school throughout the year.

Suppose the age interval for the enrolled pupils is set to be 1($n=1$), the EYS would produce the cumulative enrolment rates. This methodology is often applied by UNESCO to determine the ranking of human development index (HDI) for all countries (Rigotti et al., 2013). However, Rigotti et al. (2013) presented an alternative measurement of EYS, referred to as adjusted expected years of schooling (AEYS). The AEYS is computed with the equation (3.6) below

$$AEYS = \sum_{x=\alpha}^\omega \sum_{i=1}^z (\frac{\alpha_{ix}}{r_{ix}}) * \frac{f_{ix}}{px} \qquad (3.6)$$

Where the subscript i represents the grade of school child aged x; z is the highest grade completed by the α_{ix} represents the years of schooling completed by the pupils, up to grade i at age x; r_{ix} is the years of schooling that a regular pupils would have completed by grade i at age x; f_{ix} is the total enrolment in grade i at age x and P_{ix} population at age x .(Rigotti et al., 2013).

Education Investment

In this study, education investment represents the amount put into education development in monetary terms from the income pull. In other words, education investment variable is the amount of education expenditure as a percentage of GDP (EEXPgdp). Though there are private education investments which captures private education business in education, the study prefers the public expenditure because the government has a strong responsibility in the provision of education at all levels (Barro, 2013), such that education investment captures government public expenditure on education as a ratio of the GDP. Hence, the study expectation is that that public expenditure on education would enhance equal education distribution (Mariana, 2015).

Inflation

Inflation (*INFL*), in this study, means the persistent rise of market prices that have the purview to indirectly affect GNP per capita such that education distribution is affected by the amount of investment on education. In other words, the purchasing power, when it is low, do affect all forms of distribution such as market goods, income and education (Dobson, Clarke, Davies, & Waterson, 2001; Rogoff, 1996). The capability of the government to invest in education is constrained by the economic uncertainties such as fluctuation of inflationary rate and taxes (Herrington, 2015). So, *INFL* is a control variable in the study.

Data Collection Procedure

- **Data Source**

Data for this study were downloaded from the World Bank (2016) database for education investment (education expenditure as a percentage of GDP) and inflation, the independent variables. The data for EDINQ were obtained from United Nations Development Programme - Human Development Report (UNDP-HDR, 2015). Though the expression provided for age grade distortion as ($\frac{\alpha_{ix}}{r_{ix}}$) in calculating years of schooling (Rigotti et al., 2013), the available data got from World Bank (2016) and UNDP-HDR support the UNESCO model.

- **Nature and Data Cleaning Procedure**

The data collected on the response variable and the independent variables for the twelve countries were times series. Time series data represents set of observations over a period of time, t, where the distance from one observation to another is constant and affected with stochastic processes (Nielsen, 2004). As such, one of the requirements for the time series data analysis is to test the stationarity of the series in which the result of stationarity test would give direction to the appropriate method of analysis. The data covered 1999 to 2014 (16 data point) with a sample size of 192. Also, the set of observations vary such that we convert them the one in raw to natural logarithm.

However, some variable data collected from the World Bank have missing values. To reduce the bias of the expected results (Soley-Bori, 2013), expectation maximisation (EM) method was used to compute for the missing and replacing values because the data were missing completely at random (MCAR) (Zhou & Lim, 2014). The EM method was achieved with two steps – the expectation and maximisation steps. In expectation step, there is randomisation which makes a classification of samples into k class. The researchers followed the traditional argument of Zhou and Lim (2014) to compute and replace the missing values. This begins with the probability function as $\rho(X_i \in \beta_k)$ where the β_k is the unknown parameter or the missing values. Hence,

$$\rho(X_i \in \beta_k) = \rho(\beta_k | X_i = \rho(\beta_k) * \rho(X_i | \beta_k) / \rho(X_i)$$
$$= \rho(\beta_k) * \rho(X_i | \beta_k) / \sum_{i=1}^{k} \rho(\beta_k) * \rho(X_i | \beta_k) \qquad (3.7)$$

From the equation (3.7), the $\rho(X_i \in \beta_k)$ indicates the likelihood that sample i is related to class k. From the equation 7, there is repetition (iteration) of the expectation step to enhance accuracy.

The second step is the maximisation step which deals with the re-estimation of the statistical model parameter. The statistical model parameter is denoted as Sm_k. Hence the maximisation step is given in equation (3.8) as

$$Sm_k = \frac{1}{n} * \sum_{i=1}^{k} X_i * \rho(X_i \in \beta_k) / \sum_{i=j}^{j} \rho(X_i \in \beta_j) \qquad (3.8)$$

The equation (3.7) and (3.9) enables the researcher to replace the missing values with the use of SPSS EM algorithm. Equally, the researchers conducted panel unit root test to establish data stationarity using four methods comprising of Levin, Lin, and Chu (2002); Breitung (2001); Im, Pesaran, and Shin (2003) and Phillips and Perron (1988) ADF Fisher Chi-square tests. In panel data analysis, unit root test is a necessary condition in any type of time series for understanding the stationarity of the data.

Hence, the researchers then conducted a unit root test which explains the method to use in the panel data analysis. If all variables are stationary at level that is I(0), ordinary least square (OLS) panel analysis is sufficient. The OLS panel is applicable to analysing the coefficients with PEM, FEM and REM. However, the researchers consider eliminating the PEM because the 12 countries chosen were not unique or have similar characteristics. Although FEM and REM are better than PEM, the panel analysis suggests that the best model from the two models should be chosen (See Table 4, Hausman Test).

Data Analysis and Model Specification

This subsection explains the method of data analysis particularly model specification. The method of data analysis is panel data analysis because the observations (n) for each country was less than 30 (n < 30) to carry out a normal time series analysis. In expectation, the coefficient of public expenditure on education is expected to produce a negative relationship with the response variable, the natural log of education inequality. In the alternative, a negative coefficient of EEXP to GDP ratio would be driven by an increase in the response variable, LnEDINQ. The error components model (ECM) for the panel modelling (McManus, 2011) is stated in equation (3.9) as:

$$y_{it} = X_{it}^t \beta + c_i + \mu_{it} \tag{3.9}$$

$$wherein\ E(X_{it}^t\ \mu_{it}) = 0 \text{ and } E(X_{it}^t\ c_i) = 0$$

The expression in (3.9) implies that we assume that there is no correlation between the errors and the explanatory variables resulting in the consistency of pooled effect model (PEM). The assumption of PEM is that intercept and slope are the same for all countries which is not true. Results of PEM often results to heterogeneity bias.

Although pooled OLS estimator is consistent with the equation (3.9), it is not an efficient estimator (McManus, 2011). Due to the weakness of the PEM, the Fixed Effect Model (FEM) and Random Effect Model (REM) were considered because it minimises the heterogeneity bias of the PEM (Torres-Reyna, 2007).

Further, to determine the best panel model for this study, the researchers estimated Hausman test. Hausman test is a test of independence, in other words, a test to choose the best model between FEM and REM for a better prediction (Torres-Reyna, 2007).

Firstly, the linear regression model is specified in equation (3.10) as:

$$LnEDINQ_T = \gamma_0 + \gamma_{1i}EEXPgdp + \gamma_{2i}INFL + \zeta \tag{3.10}$$

Where γ_0 is the constant, γ_{1i} and γ_{2i} represent the model coefficients of the explanatory variables, *EEXPgdp* and *INFL* respectively. The hypotheses suggest that we should expect $\gamma_1 < 0; \gamma_2 < 0$

In panel series analysis, the researcheres took care of unobserved heterogeneity, where time is constant, and the stochastic term is not correlated with the independent variables, equation (3.10) is rewritten in (3.11) as:

$$LnEDINQ_{it} = \gamma_{0i} + \gamma_{1i}EEXPgdp_{it} + \gamma_{2i}INFL_{it} + v_{it} \tag{3.11}$$

$$Where\ v_{it} = c_i + \zeta_{it}$$

Where for each country in the panel, $t = 1.......T$ refers to the time period, ζ_{it} is uncorrelated with the explanatory variables and c_i is the unobserved heterogeneity term. Since the data are on each cross-sectional unit over time T periods, the researchers specify the model in two T periods in equation (3.12) and (2.13) as:

$$LnEDINQ_{i1} = \gamma_{0i} + \gamma_{1i}EEXPgdp_{it} + \gamma_{2i}INFL_{it} + c_1 + \zeta_{i1} \qquad (3.12)$$

$$LnEDINQ_{i2} = \gamma_{0i} + \gamma_{1i}EEXPgdp_{it} + \gamma_{2i}INFL_{it} + c_1 + \zeta_{i2} \qquad (3.13)$$

Combining equation (3.12) and (3.13), we obtain:

$$LnEDINQ_{iT} = \eta_0 + \eta_1 EEXPgdp_{iT} + \eta_2 INFL_{iT} + c_i + \zeta_{iT} \qquad (3.14)$$

In equation (3.14), the outcome of LnEDINQ has the T observations for the country i; the explanatory variables are the vector measured in time t; c_i is the unobserved in all the periods but remain constant over time and the ζ_{iT} represents the time-varying idiosyncratic error term. The composite error term is stated in equation (3.15) as:

$$v = c_i + \zeta_{iT} \qquad (3.15)$$

With econometric method, the study used generalised least square (GLS) method to estimate for the FEM and REM (McManus, 2011). In order to test for the independence, the researchers employed Hausman test (Torres-Reyna, 2007), to test for the null hypothesis expressed in Hausman equation. as:

$$W = (\alpha_{REM} - \alpha_{FEM})' \sum^{-1}(\alpha_{REM} - \alpha_{FEM}) : \ x^2(k) \qquad (3.16)$$

In this instance, the covariance of the efficient estimator minus inefficient estimator equal zero (0). Suppose W is insignificant, then report the REM estimated results.

RESULTS AND FINDINGS

This section presents the findings from the GLS estimation and discussion. Firstly, with time series data, the researchers argued and estimated the stationarity of the data. As such, the results of the panel unit root test are presented in Table 2.

Table 2
Panel Unit Root Test Result

Variable	Method 1		Method 2		Method 3		Method 4		Decision
	Levin et al. Statistics	P Value	Im et analysis. Statistics	P Value	ADF-Fisher Chi-Square Statistics	P Value	PP-Fisher Chi-Square Statistics	P Value	
LnEDINQ	-5.46	0.000*	-3.960	0.000*	56.56	0.000*	62.070	0.000*	Stationary I(0)
EEXPgdp	-4.68	0.000*	-5.110	0.000*	74.24	0.000*	71.110	0.000*	Stationary I(0)
INFL	-7.59	0.000*	-7.560	0.000*	99.02	0.000*	128.76	0.000*	Stationary I(0)

Note: Reject H_0 when * significant at p < 0.001

The results shown in Table 2 indicate that both the dependent and explanatory variables' p-values of the four methods of unit root analysis were less than the critical value of 0.05. The three variables were integrated of the same order I(0) showing that they are stationary at level. Since the study used panel time series, the stationarity of

time series data is known when the "statistical properties remain constant over time" (Nason, 2006. P.1). In consequence, the panel general least square method is estimated with fixed and random effect models. The results are presented in Table 3.

Table 3

Fixed Effect Model and Random Effect Model Results

Variable	Fixed Effect Model			Random Effect Model		
	Coefficient	**SE**	**P-value**	**Coefficient**	**SE**	**P-value**
C	3.462	0.029	0.000*	3.456	0.058	0.000*
EEXPgdp	0.023	0.007	0.001*	0.024	0.007	0.001*
INFL	-0.002	0.002	0.249	-0.002	0.002	0.320
$R^2 = 0.594$; Adjusted $R^2 = 0.564$				$R^2 = 0.074$; Adjusted $R^2 = 0.064$		

Note: DV = LnEDINQ; * significant at $p < 0.05$

The results presented in Table 3 regarding the fixed effect and random effect models look interesting, but one is better than the other because one may have efficient estimator while the other model estimator may be inefficient. Hence, to choose the best model, the researchers estimated for the Hausman test. The result is presented in Table 4.

Table 4

Hausman Test of Model Selection

Test Summary	Chi-Square Statistics	Degree of Freedom	p-value
Cross-section random	2.778	2	0.249

Note: $p > 0.05$, accept Ho)

H_0: *Random effect model is appropriate*

H_1: *Fixed effect model is appropriate.*

The Table 4 showing the p-value of the Hausman test indicates that 24.9% is greater than 5% critical value. Hence, we accept H_0 demonstrating that the random effect model is appropriate.

The individual effect for the 12 countries examined in this study is presented in Table 5.

Table 5

Education Inequality Cross-Country Effect for West Africa Countries

S/N	Name of the country	Effect	Interpretation
1	Benin	0.025*	2.52%; Positive effect
2	Cote D'Ivoire	0.070*	7.05%; Positive effect
3	Cape Verde	0.196*	19.6%; Positive effect
4	Gambia	-0.015*	1.53%; Negative effect
5	Ghana	0.257*	25.74%; Positive effect
6	Guinea	-0.075*	7.49%; Negative effect
7	Mali	-0.145*	14.51%; Negative effect
8	Mauritania	-0.001*	0.053%; Negative effect
9	Niger	-0.451*	45.13%; Negative effect
10	Sierra Leone	-0.065*	6.45%; Negative effect

| 11 | Senegal | -0.004* | 0.4%; Negative effect |
| 12 | Togo | 0.207* | 20.66%; Positive effect |

Note: * significant at p < .05

DISCUSSION

Nomura (2011) found out that demand for education would increase the challenge for poor education financing. Therefore, it is not a surprise that the result of the random effect model shows positive relationship with education inequality. The result of the twelve West African countries indicates that there is a statistically significant relationship between education expenditure as a ratio of GDP and education inequality, indicating that the volume of investment in education is insufficient to show negative relationship. The result does not support the findings of Barro (1991, 2001) that investing in education investment usually compensate for growth due to social and private benefits derive from education. In this particular study, the positive relationship suggests that there is 2.4% increase in education inequality for the period under study. In other words, a unit rise of expenditure has 2.4% increase in educational inequality thereby reduces human capital stock for the economy (Blundell et al., 1999; Krueger & Lindahl, 2001). Based on the findings, the researchers positioned that the region investment in education has a positive impact on the differentials in educational attainment, reflecting poor investment creativity in knowledge development. The existing story of poor investment in education has not faded away since 1985 when Psacharopoulos (1985) affirmed that the underinvestment in education accounts for the major problem of Africa such as low development and poverty. However, the tax base, which is the source of budgeting for public expenditure in education, is very low for many of the countries in the study (Herrington, 2015; Nomura, 2011; Nomura & Bruneforth, 2011). The low taxes, in no doubt, responsible for the share of education in the total output. Likewise, the soaring rate of enrolment mentioned in Saint (2015) might be an important factor for the dropped down expenditure in education.

Uninterestingly, the assumption that inflation rate could have an indirect relationship with the response variable was found insignificant. As such, inflation is not an important factor for the rising of educational inequality of West Africa countries. Also, the model fit (coefficient of determination, R^2) gives 0.074 (7.4%), and its adjusted value is 0.064 (6.4%). With the 7.4%, it shows that the strength of the explanatory variables is weak showing that there are many unobserved factors affecting education inequality of the region.

However, from the results of cross countries effect, seven countries have their education investment decreasing in relation to education inequality for the period under study. These include Niger (-45.1%); Mali (-14.5%); Sierra Leone (-6.45%); Guinea (-7.49%); Gambia (-1.53%); Senegal (-0.4%) and Mauritania (-0.05). Comparing the countries education investment measured by education expenditure as a ratio of GDP for these countries, Niger has the strongest effect and followed by Mali while Mauritania has a weak effect on the decreasing pattern. Other five countries that had their education investment increasing effect on education inequality are Ghana (25.7%); Togo (20.7%); Cape Verde (19.6%); Cote D'Ivoire (7.05%) and Benin (2.52%). If this group is compared, Ghana, Togo and Cape Verde have strongest positive effect in increasing education inequality during the study period than Benin and Cote D'Ivoire with little effect.

The study outcome agrees with the existing literature that inadequate investment in education would have an impact on the country's human stock. Earlier studies confirmed that an increase in capital investment to education increases the national skill of workers and promotes development (Barro, 1991, 2013; Pan, 2014). Specifically, Barro (1991) argued that additional investment in human capital would allow the developing countries to catch up with the development countries over time. Though Niger increased its expenditure from 3% of GDP in 2000 to 7% of GDP in 2014, the official out-of-school age children are still very high. This could raise an issue of the contribution of other sectors such as real sector contribution to the gross national product. Also, Bakar & Tuah, (2006).

Results support our findings that a poor expenditure on education, usually has adverse effect on the unequal educational distribution. As such, with the consistency of the results with the previous findings, we suspect that investment in education is key indicator to raise the status of West African education at global and national levels.

CONCLUSION AND POLICY IMPLICATION

This paper thoroughly considered the education investment in twelve West African countries with implication for reduction of inequality of education that cut across the region. The study covered the gap regarding examination of the impact of education investment on educational inequality of the West Africans. The researchers observe that cumulatively, the governments of the region invested an average of 4.58% of GDP to education within the realm of existing data. With our findings, the amount invested is grossly insignificant to reduce the magnitude of education inequality of the region as confirmed in UNDP-HDR (2015) ranking. Although seven countries had their education inequality decreasing during the study period; cumulatively, the public education investment has an increasing effect on education inequality. Furthermore, suppose explanatory variables are held constant, the total education inequality of the region equals 34.6%. So, it can be argued that the dominating effect of education inequality in the West African countries was due to poor creativity in knowledge creation through government public expenditure that goes to education (Sternberg, 2012). Logically, economic growth and development alongside togetherness with poverty reduction of the region depend on improving public spending that goes to education (Pan, 2014).

While creativity of investment in knowledge is theoretically supported to improve human development, the study outcome demonstrates that poor education investment contributes to unequal education in the West African countries. As such, the region is expected to consistently develop a five-year expenditure rolling plan (ERP) on education for increasing human capital stock leading to a knowledge-based economy. Hence, the researchers argue that the reduction in education inequality depends on the level of government public expenditure that is budgeted to education. In that case, the suggestion of UNESCO to have a higher rate of expenditure as a ratio of GDP for financing education should be strictly followed in the annual government budgeting. However, since there is a considerable number of unobserved indicators influencing education inequality that are not examined in this study, further study need be done to capture savings attitude, consumption pattern and corruption effect. Countries like Niger should be re-examined to observe why the education inequality is high despite an increase in government expenditure that goes to education.

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