Education expenditure and economic growth: Some empirical evidence from Côte d'Ivoire

Kouton, Jeffrey

Ecole Nationale Supérieure de Statistique et d'Economie Appliquée d'Abidjan (ENSEA)

31 July 2018

Education expenditure and economic growth: Some Empirical Evidence from Côte d'Ivoire

Jeffrey Kouton

Ecole Nationale Supérieure de Statistique et d'Economie Appliquée d'Abidjan (ENSEA)
Abidjan, Côte d'Ivoire

Email: jeffrey.kouton@gmail.com

Abstract

There are many recent studies on African countries about the relationship between education expenditure and economic growth. However, the case of Côte d'Ivoire has been so far neglected. The aim of this paper is then to investigate that relationship for Côte d'Ivoire for the period from 1970 to 2015. We applied the Pesaran et al. (2001) bounds testing approach, estimated an ARDL model and used the Toda and Yamamoto (1995) causality test. The study provides evidence of the existence of a negative and significant long term effect of government education expenditure on economic growth for the aforementioned period. Moreover, there is a non-significant positive effect of government education expenditure on economic growth in the short term. The results show a unidirectional causality relationship between the two variables, running from education expenditure to economic growth. These findings are consistent with some results in the empirical literature and, first, indicate that government education expenditure does not stimulate economic growth in Côte d'Ivoire. This may be due to low levels of government education expenditures and the inefficiency with which these expenditures are converted into human capital stock and thus into economic growth. Second, policies aiming to invest more in education are important for more production and more economic growth.

Key Words: ARDL bound test, Causality, Education expenditure, Economic growth.

1. Introduction

Investments in education are among the factors that determine the development of education sector. This is particularly true for developing countries. Specifically, expenditures on education represents human capital development as they can help in having better education outcomes. So far, the role of education in increasing human capital stock and enhancing economic growth has been widely acknowledge in the theoretical literature (See for example Becker, 1964; Barro, 1991; Benhabib and Spiegel, 1994). Yet, the gains of education are not effective in all countries. Indeed, the empirical literature of the education expenditure-economic growth nexus is mixed. The results range from a positive to a negative or inexistent effect of education expenditure on economic growth.

Considering the specific case of Côte d'Ivoire, although the country's economic growth is among the highest and the fastest of sub-Saharan Africa, the main challenge that the country must face now is to find means to have an inclusive growth. Many factors among which education, through the enhancement of human capital, can allow to achieve the inclusive growth. According to Tandi (2013), the quality of the performance of education systems is an important factor in attaining inclusive growth as education could be seen as a competitive factor. Manafi and Marinescu (2013) enlightened the effect of investment in education on inclusive growth. Raheem et al. (2018) support that government expenditure in education plays an important role in achieving inclusive growth. In Côte d'Ivoire, Education sector appears to be one of the sector which received since several years less but growing effort compared to other sectors such as the Building and Public Work sector.

The main objective in this paper is to analyze the short and long run relationship between education and economic growth in Côte d'Ivoire from 1970 to 2015. To this end, the paper applies the Pesaran et al. (2001) bounds testing approach, estimates an ARDL and test for causality using the Toda and Yamamoto (1995)

causality test. So far, only few papers analyzed the relationship between education expenditure and economic growth using ARDL model, especially in Africa. To the best of our knowledge, this is the first attempt to analyze the relationship between education expenditure and economic growth in Côte d'Ivoire using these techniques of estimation.

The choice of Côte d'Ivoire is also motivated by the fact that so far, although there is a growing literature on the relationship between education expenditure and economic growth in Africa, little effort has been made to analyze this relationship for Côte d'Ivoire. This paper is then an attempt to fill this gap of the literature.

The paper is structured as follows. Section 2 provides a literature review. Section 3 describes the data and outlines the methodology. Section 4 presents and explains the results, while Section 5 concludes.

2. Literature review

The relationship between education expenditures and economic growth has received increasing attention during the last two decades.

Musila and Belassi (2004) assessed the relationship between government education expenditure per worker and economic growth in Uganda during 1965 and 1999. Using error correction model and cointegration estimates, the results suggested a positive and significant effect of government education expenditure per worker on economic growth.

Wadad and Kalakech (2009) by the mean of a cointegration analysis found for Lebanon a positive effect of government expenditure in education on economic growth in the long term but a negative effect in the short term.

Considering the case of Nigeria, Omojimite (2010) used both cointegration and granger causality analysis to investigate the education-economic growth nexus during the period 1980-2005. The results suggested a cointegration relationship between public expenditures on education, primary school enrolment and economic growth. Moreover, there is a unidirectional causality from public expenditures on education to economic growth. However, there is no causality from primary school enrolment to economic growth. The author explained this last result by the fact that the teaching program of Nigeria's primary school is based on the one of Western education system and, thus, don't take into account local reality.

Following Omojimite (2010), Urhie (2014) analyzed the effect of public education expenditure on education attainment and economic growth in Nigeria from 1970 to 2010. The particularity of the study is that the author disaggregated public education expenditure in two components. The first one is the recurrent expenditure (teachers' salary, meal subsidy to students…) on education and the second one is the capital expenditure on education. The methodology used by the author relies on an Instrumental Variable Two Stage Least Squares approach. The results revealed a positive impact of education capital expenditure on education but a negative effect on economic growth. Besides, there is a negative effect of education recurrent expenditure on the level of education and a positive and significant effect on economic growth. One interesting result is that there are both indirect and direct effect of public education expenditure on economic growth in Nigeria. Urhie (2014) justified his result by the multiplier effect of recurrent expenditure on economic growth (direct effect). Moreover, although the education expenditures might not be used in the education sector, the rest of the economy could benefit of it. Also, even if investments on education increase, there is not necessarily a gain in enrolment rates.

Still considering the case of Nigeria, Ndiyo (2007) and Nurudeen and Usman (2010) found a negative effect of public expenditure in education on economic growth respectively in the periods 1970–2000 and 1970–2008. In their paper, Nurudeen and Usman (2010) insisted on the fact that Nigeria's expenditures on education should be increased.

In a paper written by Mekdad et al. (2014), the relationship between public education expenditure and economic growth in Algeria has been investigated. They used error correction model and Granger causality test and found that public education expenditure positively impacts on economic growth in Algeria during the period 1974-2012.

Owusu-Nantwi (2015) analyzed the relationship between education expenditure and economic growth in Ghana during the period from 1970 to 2012. Using a vector error correction model and a cointegration analysis, the author shows out that in the long term, education expenditures affects positively and

significantly the real GDP. In the short run, the results suggested, contrary to Omojimite (2010), that there is a bidirectional causal relationship from education expenditure to real GDP.

Nketiah-Amponsah (2009) showed that there is no relationship between public education expenditure and growth for Ghana during the period 1970-2004.

Using Johansen cointegration and causality techniques, Bosupeng (2015) assessed the long run relationship between economic growth and education expenditure for Bostwana during the period 1960-2013. The results suggested the absence of a long run relationship. The author justified this by the fact that it may take time before better education can translate into higher productivity because graduates have to go through one or more education cycles. The study also found an absence of causality between education expenditure and economic growth.

By the mean of a Vector Error Correction Model, Douanla and Abomo (2015) have paid attention to the effect of government spending in education on economic growth in Cameroon during the period 1980-2012. They analyzed this relationship in a long term and a short term frameworks and found a positive and significant impact of government education expenditure on economic growth. The authors emphasized on the role of the government of Cameroon in proceeding to the quantitative and qualitative improvement of supply of educational services.

Otieno (2016) explored the effect of education expenditure per worker on economic growth for Kenya over the period 1967-2010. The major result is that education expenditure per worker has a positively and significantly affect economic growth in both long term and short term. The methodology used by the author relies on Granger causality and an Error correction model. The author underlines the necessity for the Kenya Government to increase investments in education.

Sunde (2017) estimated for Mauritius the relationship between education expenditure and economic growth from 1976 to 2016. Basing on an ARDL bounds testing approach and Granger causality test, his paper highlighted a unidirectional short term causality running from education expenditure to economic growth for the aforementioned period. Moreover, a long run relationship was found between the two variables, leading to the conclusion that an increase in either of the variables could lead to an increase in the other variable.

The Asian and Western countries cases are discussed as well in the literature. Prontzas et al. (2009) examined the impact of public education expenditures on Greek economy's growth from 1960 to 2000. The results revealed that the effect of public education expenditures on economic growth is positive and statistically albeit very weak.

Vijesandran and Vinayagathasan (2014) examines the dynamic relationship between human capital and economic growth in Sri Lanka using a cointegration approach. Their measure of human capital uses an index of education calculated on the basis of the adult literacy rate, the gross enrollment rate and a health index calculated on the basis of life expectancy. The results suggest a positive long-run relationship between health and economic growth but the relationship between education and economic growth is negative in the long run. They explain this second result by the existence of a certain delay between the end of the training and the entrance on the labor market, which means that the impact on growth is not immediate. Also, the authors report an inadequacy between academic training and the needs of the labor market. They also found a positive short-run relationship between health and economic growth.

Yildirim et al. (2011) found a causality relationship from economic growth to government expenditures on education during the period of 1973 to 2009 using Toda and Yamamoto (1995) causality analysis. Their results also revealed that public education expenditures do not lead to economic growth in Turkey. They proposed two explanations to that result. The first argument is that expenditures on defense overwhelmed education expenditures during the period 1924-1996. The second argument is the proportion of expenditures on education in total public expenditures is historically relatively low.

Mehmet and Sezer (2014) also focused on Turkey and, for the period 1970-2012, analyzed the effect of education expenditure on economic growth. Using ARDL and cointegration analysis to deal with both short and long runs, the results of the estimations show that there is a positive effect of education expenditure on economic growth. According to the authors, this result could be explained by a transfer of opportunities of knowledge production and manufacturing process of universities generated by an increase in education expenditure which finally lead to the rise of economic growth.

Abubakar and Abdulkadir (2015) found an absence of long term relationship between education expenditure

and economic growth in India during the period 1980-2012. They also found a short term unidirectional causality from education expenditure to economic growth. They justified their results by the fact that education expenditure is oriented toward unproductive expenditures, such as payments of salaries, than productive expenditures such as establishment of more educational institutions and procurement of adequate learning facilities. The methodology adopted by the authors relies on Johansen cointegration techniques, VAR model and Granger causality test.

Using similar methods as Abubakar and Abdulkadir (2015), Mallick and Dash (2015) investigated the causal relationship between expenditure on education and economic growth. But contrary to Abubakar and Abdulkadir (2015), Mallick and Dash (2015) found a long term relationship between expenditure on education and economic growth in India. Nevertheless, they obtained a unidirectional causality from expenditure on education to economic growth as pointed out by Abubakar and Abdulkadir (2015).

Beyond the country-level analysis, researches also focused on panel data analysis of the relationship between education and economic growth.

Earlier in the 90s, Devarajan et al. (1996) showed a negative relationship between the education expenditures in percentage of government total expenditure and economic growth for a panel dataset of 43 developing countries from 1970 to 1990. The authors explained this result by the excessive expenditures (size effect).

Al-Yousif (2008) considered the case of the GCC (Gulf Cooperation Council: Saudi Arabia, Kuwait, United Arab Emirates, Bahrain, Oman, and Qatar) countries and examined the relationship between education expenditure and economic growth for the period 1977-2004. In his study, he made use of error correction model and Granger causality methods. The core result of the study is that one could not generalize across countries the relationship between education expenditure and economic growth. Indeed the author found a long-run relationship between the variables for all the countries except Kuwait. The short term causality results is also mixed across countries. For Saudi Arabia, there is a reverse causality between education expenditure and economic growth. This could be the result of an increase in government expenditure in education, due to an increase in oil revenues, which lead to the rise of the GDP. But, in Kuwait, the author found a unidirectional causality from economic growth to education expenditure.

Jiang et al. (2011) examined the threshold effects of investments in higher education on income disparities between urban and rural areas in China. The data used concern 28 Chinese provinces on the period 1988-2007. The authors estimated two models. The first model is based on a threshold detection method. The threshold variable used is GDP per capita. The second model is a dynamic panel model. This variable measures the delayed effects of the investment in human capital on the economy. The results suggest a U-inverted relationship between human capital investments and income gaps.

Idrees and Siddiqi (2013) found that the long run positive impact of public education expenditures on economic growth is higher in developing countries comparatively to developed countries. They emphasized on the fact that high quality education and education for all is important in the production process. They also argued that educational institutions is a determinant of development. To obtain that result, the authors employed Kao and Pedroni cointegration test and Panel Fully Modified Ordinary Least Square method. Focusing on the period 1990-2006, their sample contains United Kingdom, United States, Canada, Germany, France, Italy and Japan as developed countries and Pakistan, India, China, Turkey, Poland, Russia and South Africa as developing countries.

Benos and Zotou (2014) used a meta-regression analysis to examine the effect of education on economic growth. A meta-regression was applied on 57 studies with 989 estimates. The authors found that there is an important bias in favor of a positive effect of education (education expenditures, schooling years, student/teacher ratios…) on economic growth. Yet, the results suggested that the effect varies from on study to another. These differences are due to several factors among which the econometric methods used, the variables used, the type of study (working paper or publication), etc.

Eggoh et al. (2015) showed that the education public expenditures has a negative impact (in long and short runs) on economic growth in 49 African countries during the period 1996-2010. The enrollment in primary and secondary have a small positive impact on economic growth. The authors explain these results by the low level of public education expenditures and the inefficiency with which these expenditures are converted into human capital stock. According to them, this inefficiency could for example be explained by structural and institutional factors. The methodology used to obtain these results is as follows. Firstly, the authors capture the long-run relationship between human capital and economic growth with cross-sectional data. Secondly,

the authors use the GMM method developed for dynamic panel models to capture the short-run dynamics. Considering the case of European Union and BRICS countries, Zoran (2015) found a positive effect of public expenditure on education on economic growth.

Mallick et al. (2016) focused on 14 Asian countries and searched for the effect of education expenditure on economic growth during the period 1973-2012. They employed Pedroni cointegration test, FMOLS (Fully Modified Ordinary Least Square) and Panel Vector Error Correction methods. They obtained a long term relationship between education expenditure and economic growth. Their results also provided evidence of a positive and significant effect of education expenditure on economic growth. Furthermore, they found both short and long terms causality from economic growth to education expenditure, and a causality running from education expenditure on economic growth in the long term. According to Mallick et al. (2016), the government education expenditure is likely to generate skilled labor force productivity and to create better human capital. These are factors which are important for the role of modern technology in enhancing economic growth in the 14 selected Asian countries.

The previously discussed literature review generally supports a positive relationship between education expenditure and economic growth while focusing on long run and short run. However some of the studies point out a negative effect of education expenditure on economic growth. Causality mechanisms are also identified between the two variables. Regarding the methodology used, only few studies used ARDL bound testing approach.

3. Data and methodology

In this section the data and the econometric framework used for this paper are presented. The empirical procedure involves four steps. We first examine the stochastic properties of our data. After studying the unit root properties of the data, the study used three different econometric approaches to analyze the relationship between education and economic growth in Côte d'Ivoire. In fact, in addition of employing the bound test co-integration approach of Pesaran et al. (2001), we estimate an Auto Regressive Distributed Lag (ARDL) model. These two econometric techniques will allow us to deal with the potential long term and short term relationship between education expenditure and economic growth. After that, the Toda and Yamamoto (1995) causality test is performed to test the causal relationship between education expenditure and economic growth.

3.1. Data and sources

In the empirical analysis, we have used secondary annual data on gross domestic product (GDP) and education expenditure (% GDP) for the period 1970-2015. This period is chosen of time because there has been significant economic, political and social changes in Côte d'Ivoire during this period.

Real GDP is used to measure economic growth, and government expenditure on education (% GDP) is a measure of the education expenditure. This latest variable is widely used in both theoretical and empirical literature. We also control for some socio-economic variables namely: financial development, life expectancy at birth and inflation. The effect of financial development on growth has been the subject of numerous empirical studies. For example, Eggoh (2009) shows that financial development is positively associated with growth. In this study, financial development is measured by the broad money/GDP ratio. Life expectancy at birth is used to control for health stock. The inflation variable is used to control for the macroeconomic instability. All the variables are taken from the World Development Indicators Database. Table 1 provides a summary of some descriptive statistics for the variables.

Table 1: Descriptive statistics

	Obs.	Mean	Median	Max.	Min.	Std. Dev.	Skewness	Kurtosis
log(GDP)	46	23.695	23.617	24.249	23.015	22.339	0.509	3.571
EDUC	46	5.682	5.778	8.231	3.669	1.471	0.031	1.305
LE	46	49.530	49.727	53.053	43.695	2.513	-0.353	2.103
BROAD	46	27.709	27.400	37.565	18.160	4.473	-0.026	2.688
INFLATION	46	6.218	4.126	27.422	-0.806	6.472	1.592	5.337

Note: GDP= Real Gross Domestic Product; EDUC= Government education expenditure (% GDP); LE=Life Expectancy at Birth; BROAD= Broad money (% GDP); INFLATION= Inflation rate

Table 2 shows the correlation matrix for the variables.

Table 2: Correlation matrix

	GDP	EDUC	LE	BROAD	INFLATION
GDP	1.000				
EDUC	-0.650***	1.000			
LE	0.379***	0.359**	1.000		
BROAD	0.033	0.421***	0.551***	1.000	
INFLATION	-0.350**	0.257*	-0.039	0.187	1.000

Note: GDP= Real Gross Domestic Product; EDUC= Government education expenditure (% GDP); LE=Life Expectancy at Birth; BROAD= Broad money (% GDP); INFLATION= Inflation rate. *, **, *** indicate significance at 10%, 5% and 1% respectively.

From the correlation matrix, inflation and government education expenditure are negatively correlated with GDP while life expectancy at birth and broad money are positively correlated with government education expenditure. Table 2 also shows that there is no risk of multicollinearity between the explanatory variables.

3.2. The unit root tests

Due to the possible spurious and unrelated regression issue that may rise due to the presence of unit-root, one should be proceed step by step by first testing for unit roots. The unit root tests are performed in order to make sure that the variables are not integrated of order two or higher. In this study, the Zivot-Andrews (1992) unit root test is used. The test accounts for structural break. Indeed, Côte d'Ivoire faced many socio-political crises that affected its economy and thus causing breaks in the socio-economic variables evolution. Moreover, the Zivot-Andrews (1992) test searches for breaks endogenously. The null hypothesis of the test is the presence of unit root with structural break. It should be noted that the structural break can be in the intercept, in the trend or in both intercept and trend. The test is thus implemented for each type of break.

3.3. Testing for cointegration

To examine the long-run relationship between education expenditure and economic growth in Côte d'Ivoire, the bounds testing approach to cointegration proposed by Pesaran et al. (2001) is used. We use this approach given the small sample size (46 observations). Indeed, this approach offers efficient results for small samples. Moreover, the test can be used even if the variables are I(0) or I(1).
To run the bound test, one should estimate the unrestricted error correction model presented in Equation (1):

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{m} \beta_{1i}\Delta GDP_{t-i} + \sum_{i=0}^{n} \gamma_{1i}\Delta EDUC_{t-i} + \sum_{i=0}^{p} \delta_{1i}\Delta LE_{t-i} + \sum_{i=0}^{q} \theta_{1i}\Delta BROAD_{t-i} + \sum_{i=0}^{k} \lambda_{1i}\Delta INFLATION_{t-i} + \varphi_1 GDP_{t-1} + \varphi_2 EDUC_{t-1} + \varphi_3 LE_{t-1} + \varphi_4 BROAD_{t-1} + \varphi_5 INFLATION_{t-1} + \varepsilon_t$$

(Equation 1)

Where GDP is the real Gross Domestic Product, EDUC is the government education expenditure (% GDP), LE is Life Expectancy at Birth, BROAD is the broad money (% GDP). INFLATION is the inflation rate. It should be noted that except INFLATION, all the variables are taken in the natural logarithm.
Δ is the difference operator, ε_t is the error term and assumed to be independently and identically distributed, *t* is the time period. The letters *m, n, p, q* and *k* stand for the lag lengths. We use the Akaike Information Criteria to select the optimal lags. Due to the size of our sample, the maximum lag length was fixed at 4.
Pesaran et al. (2001) developed an F-test based on the null hypothesis of no cointegration ($\varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = \varphi_5 = 0$). However, the distribution of the F-statistic is non-standard. Thus, Pesaran et al. (2001) computed critical values for the bound test. Yet, according to Narayan and Smith (2005), the Pesaran et al. (2001) critical values are not suitable for small samples as in this study (46 Observations). We then used the critical values computed by Narayan (2005) for samples ranging from 30 to 80 observations. If the F-statistic is higher than the upper bound of the critical values then one could reject the null hypothesis of no cointegration.

3.4. The ARDL model

After checking for cointegration, the ARDL model is used to deal with both short and long term relationship between education expenditure and economic growth in Côte d'Ivoire. According to Pesaran and Shin (1999), the ARDL method is quite superior to the other existing cointegration techniques such as the Johansen (1988) and Johansen and Juselius (1990) approaches. In fact, contrary to those methods, the ARDL model provides strong result even when variables are integrated of different orders (I(0), I(1)). However, one should precise that before estimating the ARDL model, the dependent variable must be I(1). For this study, the ARDL model is specified as follows:

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{m} \beta_{1i}\Delta GDP_{t-i} + \sum_{i=0}^{n} \gamma_{1i}\Delta EDUC_{t-i} + \sum_{i=0}^{p} \delta_{1i}\Delta LE_{t-i} + \sum_{i=0}^{q} \theta_{1i}\Delta BROAD_{t-i} + \sum_{i=0}^{k} \lambda_{1i}\Delta INFLATION_{t-i} + \varphi EC_{t-1} + \mu_t$$

(Equation 2)

Where EC_{t-1} is the one-period lagged error correction term and φ is the speed of adjustment parameter.
Once the model is estimated, one should proceed to diagnostic tests of normality, serial correlation, heteroscedasticity and stability. As suggested by Pesaran et al. (2001), we test for stability using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests of recursive residuals of Browns et al. (1975).

3.5. Causality test and variance decomposition analysis

The causal relationship between education expenditure and economic growth is tested using the Toda and Yamamoto (1995) causality test. Contrary to the Granger (1969) causality test, the Toda and Yamamoto (1995) test can be used without checking for unit root and cointegration. This is where resides the strength and the advantage of the test, since it can be implemented even when the series are integrated of different orders. The test is an augmented VAR model in levels. In this study, the model is presented as follows in Equation 3:

$$\begin{bmatrix} GDP_t \\ EDUC_t \\ LE_t \\ BROAD_t \\ INFLATION_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \\ \alpha_5 \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \beta_{1i} & \gamma_{1i} & \delta_{1i} & \theta_{1i} & \varphi_{1i} \\ \beta_{2i} & \gamma_{2i} & \delta_{2i} & \theta_{2i} & \varphi_{2i} \\ \beta_{3i} & \gamma_{3i} & \delta_{3i} & \theta_{3i} & \varphi_{3i} \\ \beta_{4i} & \gamma_{4i} & \delta_{4i} & \theta_{4i} & \varphi_{4i} \\ \beta_{5i} & \gamma_{5i} & \delta_{5i} & \theta_{5i} & \varphi_{5i} \end{bmatrix} \begin{bmatrix} GDP_{t-i} \\ EDUC_{t-i} \\ LE_{t-i} \\ BROAD_{t-i} \\ INFLATION_{t-i} \end{bmatrix} + \sum_{j=1}^{p+dmax} \begin{bmatrix} \beta_{1j} & \gamma_{1j} & \delta_{1j} & \theta_{1j} & \varphi_{1j} \\ \beta_{2j} & \gamma_{2j} & \delta_{2j} & \theta_{2j} & \varphi_{2j} \\ \beta_{3j} & \gamma_{3j} & \delta_{3j} & \theta_{3j} & \varphi_{3j} \\ \beta_{4j} & \gamma_{4j} & \delta_{4j} & \theta_{4j} & \varphi_{4j} \\ \beta_{5j} & \gamma_{5j} & \delta_{5j} & \theta_{5j} & \varphi_{5j} \end{bmatrix} \begin{bmatrix} GDP_{t-j} \\ EDUC_{t-j} \\ LE_{t-j} \\ BROAD_{t-j} \\ INFLATION_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{bmatrix}$$

Equation (3)

Where *p* is the optimal lag-length of the VAR model at level and *dmax* is the maximum order of integration of series in the system. The *p* optimal lag-length must be determined in an appropriate way, using the information criteria for example. The first step of the test is to estimate the VAR(p+dmax) model. The Toda and Yamamoto (1995) test applies a standard Wald test to the first lagged *p* explanatory variables. If we want to test for a causality running from EDUC to GDP, the null hypothesis is: $\gamma_{11} = \gamma_{12} = \cdots = \gamma_{1p} = 0$ (EDUC does not cause GDP). In the same way, the causality from GDP to EDUC is tested by specifying the null hypothesis: $\beta_{21} = \beta_{22} = \cdots = \beta_{2p} = 0$ (GDP does not cause EDUC).
After the causality test, a variance decomposition analysis can be performed in order to evaluate the strength of the causality between the variable. Basically, the variance decomposition aimed to check the extent to which the predicted error variance for a given variable is explained by the innovations generated throughout each independent variable.

4. Presentation and Discussion of the results

In this section, the results of the empirical testing are presented. Firstly, we present the unit root test results. Secondly, we deal with the cointegration test of Pesaran et al. (2001). Thirdly, the result of the ARDL model is presented. Fourthly, the causality test and variance decomposition results are presented.

4.1. Unit root test results

We determine the unit root property of the series using the Zivot and Andrews (1995) unit root test. The results are presented in Table 3 and suggest that for GDP and BROAD, there is evidence of unit root in the series. Indeed, the Zivot-Andrews t-statistics are greater than the 5% critical values. These results show that GDP and BROAD series are integrated of order one for any of the model chosen. Moreover, the test on the Life Expectancy at Birth variable show that t-statistics are lower than the 5% critical values regardless the model used. This allow us to say that this variable is stationary at level. Finally, for EDUC and INFLATION, the null of presence of unit root with structural break is accepted for the model with break in trend. But with the other models, EDUC and INFLATION are integrated of order one.
We now discuss of the years of breaks of the some of the variables. For the GDP, the break which occurs in 1987 may be due to the structural adjustment program that Côte d'Ivoire faced like many over African countries during the period 1980-1994. For the EDUC variable, the break of 1994 may be related to the change in the political regime in 1994. As we can see from Fig. 1, there is a brutal decline in the evolution of the government expenditure in education in 1994. Concerning LE (Life Expectancy at birth), Fig.2 shows a drop which starts from 1990 and continue until 2002. Starting from 2004, Life Expectancy at Birth started to rise again. For INFLATION, the 1994 break is due to the devaluation of FCFA which occurs in 1994.

Table 3: Zivot-Andrews unit root test results

Variables	Model A: Break in Intercept				Model B: Break in Trend				Model C: Break in both Trend and Intercept			
	Break	Lag	Min. t-stat	5% critical value	Break	Lag	Min. t-stat	5% critical value	Break	Lag	Min. t-stat	5% critical value
GDP	1987	3	**-3.621**	**-4.93**	2009	3	**-3.786**	**-4.42**	2009	3	**-3.931**	**-5.08**
EDUC	1994	4	-7.221	-4.93	2006	4	**-3.428**	**-4.42**	1994	4	-6.803	-5.08
LE	1990	3	-5.783	-4.93	2004	3	-4.318	-4.42	2002	3	**-4.921**	**-5.08**
BROAD	2007	0	**-3.886**	**-4.93**	2005	0	**-3.787**	**-4.42**	2003	0	**-4.554**	**-5.08**
INFLATION	1994	4	-7.221	-4.93	2006	4	**-3.429**	**-4.42**	1994	4	-6.803	-5.08

Note: GDP= Real Gross Domestic Product; EDUC= Government education expenditure (% GDP); LE=Life Expectancy at Birth; BROAD= Broad money (% GDP); INFLATION= Inflation rate.

4.2. The Pesaran et al. (2001) cointegration test result

The bound test result for cointegration is reported in Table 4. From this table, the F-statistic is greater than the 5% upper bound critical value. Accordingly, there is enough statistical evidence against the null hypothesis of no cointegration. We conclude that there is long run causal relationship between government education expenditure and economic growth in Côte d'Ivoire.

Table 4: ARDL bound test result for cointegration

(Number of covariates)	F-statistic	Critical value at the level of significance 5%	
		Lower Bound	Upper Bound
4	5.773	3.892	5.173

Fig. 1: Government expenditure on education (% GDP) in Côte d'Ivoire from 1970 to 2015.

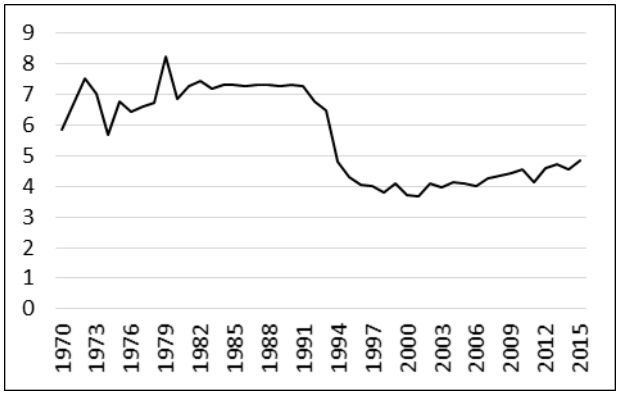
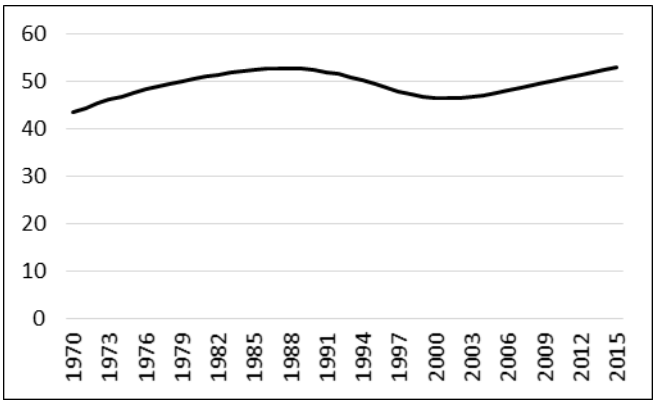


Fig. 2: Life Expectancy at Birth (in years) in Côte d'Ivoire from 1970 to 2015.



4.3. The model estimation results

After finding a cointegration relationship between our variables our interest, we now proceed to the estimation of the ARDL model in order to confirm the long run relationship. The suitable ARDL model that we have estimated is ARDL(2,1,0,2,0). Indeed, Fig. 3 shows that the AIC is minimum for the selected lags. Table 5 reports the result of the estimation of the model and some diagnostic tests results are presented in Table 6. The stability checks are presented in Fig. 4 and Fig. 5.

Before proceeding to the interpretation of the results, we validate the model using the diagnostic and stability tests.

Table 6 shows that the error terms are normally distributed, are not auto correlated and are homoscedastic. Furthermore, the Adjusted R-square suggests that the explanatory variables variations explain a high portion of the GDP variation. Since the diagnostic tests are all robust, this is the sign that the model estimated fits well with the data used.

According to Brows et al. (1975), the CUSUM test is able to detect systematic eventual movements where the coefficients values reflecting a possible structural instability. Furthermore, the CUSUM Square test detects movements that do not have for origin a structural change in coefficients. Since the statistics do not cross the 5% critical bounds (as we can see from Fig.4 and Fig.5), there is no evidence of parameter instability in the model. This guarantee both cointegration and parameter stability.

Table 5: ARDL (2,1,0,2,0) model long term and short term coefficient estimates

Dependent variable: GDP	
Covariates	
Long term coefficients estimates	
EDUC	-1.077*** (0.096)
LE	2.814*** (0.686)
BROAD	0.506** (0.240)
INFLATION	0.002 (0.004)
C	12.897*** (2.151)
Short term and Error correction coefficients estimates	
GDP (-1)	0.227** (0.107)
EDUC	0.004 (0.059)
LE	1.232** (0.531)
BROAD	-0.014 (0.053)
BROAD (-1)	-0.092 (0.058)
INFLATION	0.0002 (0.0009)
ECT(-1)	-0.277*** (0.004)

Note: GDP= Real Gross Domestic Product; EDUC= Government education expenditure (% GDP); LE=Life Expectancy at Birth; BROAD= Broad money (% GDP); INFLATION= Inflation rate. *, **, *** indicate significance at 10%, 5% and 1% respectively.

Table 6: Diagnostic tests results

Diagnostic tests	Test Statistics (Pvalues)
Adjusted R2	0.98
Jarque Bera Normality test	1.534 (0.464)
Breusch - Godfrey Serial Correlation LM test	2.053 (0.358)
Breusch-Pagan-Godfrey Heteroskedasticity test	13.239 (0.152)

Note: Values in brackets are Pvalues.

Fig. 3: Optimal lags selection for the ARDL model

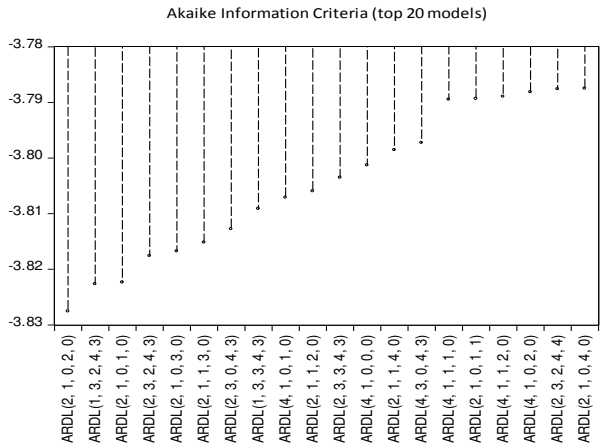


Fig. 4: CUSUM Stability test

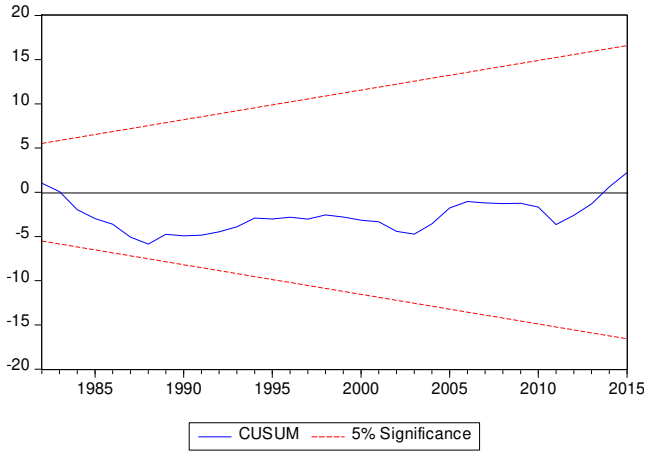


Fig. 5: CUSUM SQUARE Stability test

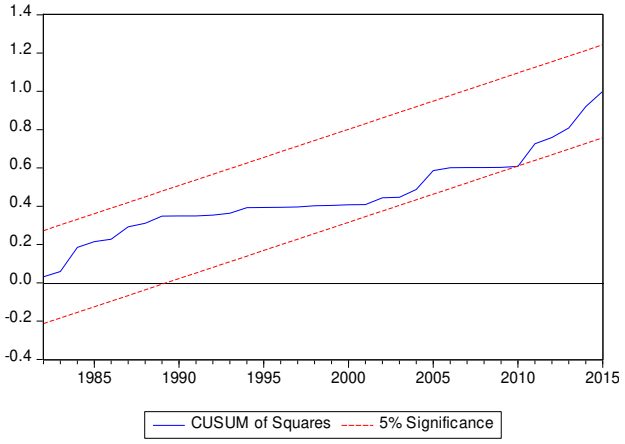


Table 7: Long term estimates using FMOLS

Dependent variable: GDP (Log of Real Gross Domestic Product)	
Covariates	
EDUC	-0.879*** (0.038)
LE	3.216*** (0.234)
BROAD	0.138** (0.068)
INFLATION	-0.005*** (0.001)
C	12.189*** (0.804)

Note: GDP= Real Gross Domestic Product; EDUC= Government education expenditure (% GDP); LE=Life Expectancy at Birth; BROAD= Broad money (% GDP); INFLATION= Inflation rate. *, **, *** indicate significance at 10%, 5% and 1% respectively.

The results from Table 5 suggest that the one period lagged error correction term (ECT (-1)) estimated is -0.277. The ECT is negative and significant at the 1% level. This suggest that after a shock, the speed adjustment of the system back to the long term equilibrium is 27.7%. This means that 27.7% of the disequilibrium from the previous year's shock is eliminated in the current year.

Concerning the effect of government education expenditure on economic growth, the former negatively and significantly impact on the latter. To ensure that the negative effect of government education expenditure on Cote d'Ivoire's economic growth does not depend on the econometric technique used, we test for robustness by estimating the long term effect using the Fully Modified Ordinary Least Square (FMOLS) method. This technique yields not only to consistent estimation of the cointegrated vector but also take into account the presence of unit roots among the series. The results are reported in Table 7 and show that the negative effect is still valid.

In the short term, the effect of government education expenditure on economic growth is positive but non-significant.

Concerning the control variables, the result regarding inflation shows positive but non-significant effect of inflation rate economic growth when we used the ARDL model. But the effect turns out to be negative albeit small when FMOLS is used. Financial development, measured by broad money has a non-significant effect on economic growth in the short term meanwhile a positive impact is observed on the long term. Life expectancy at birth has a positive effect on Cote d'Ivoire's economic growth. This result suggests that health human capital plays an important role in Côte d'Ivoire. This is consistent with the theoretical and empirical literature.

4.4. The causality test and variance decomposition results

The optimal lag selected for our VAR model is $p = 1$. Since the maximal order of integration of the variables used in this study is 1, the order of the level VAR that we will estimate in the Toda-Yamamoto procedure is $p+dmax = 2$. Here, we only presents in Table 8 the causality relationship between education expenditure and economic growth.

Table 8: Results of the Toda and Yamamoto causality test

	Test statistic	Pvalue
EDUC does not cause GDP	18.769**	0.000
GDP does not cause EDUC	0.165	0.685

Note: ** Indicates significance at the 5% level.

The results from Table 8 show that there is a unidirectional causal relationship between government education expenditure and economic growth in Côte d'Ivoire, with the causality going from the former to the latter.
Once the causality analysis is done, we now proceed to the variance decomposition analysis in order to see how strong is that causality relationship. The results are displayed in Table 9.

Table 9: Variance decomposition results

Variance Decomposition of GDP						
Period	S.E.	GDP	EDUC	BROAD	LE	INFLATION
1	0.032	100.000	0.000	0.000	0.000	0.000
2	0.052	74.163	25.159	0.383	0.116	0.180
3	0.076	54.892	42.877	0.410	0.402	1.419
4	0.103	46.228	49.847	0.397	0.856	2.672
5	0.131	42.568	51.861	0.361	1.713	3.497
6	0.163	40.937	51.183	0.277	3.598	4.005
7	0.201	39.745	47.709	0.183	8.033	4.329
8	0.249	37.197	39.817	0.286	18.276	4.424
9	0.327	30.396	26.217	1.068	38.349	3.970
10	0.485	18.557	11.910	2.821	63.974	2.737
Variance Decomposition of EDUC						
Period	S.E.	GDP	EDUC	BROAD	LE	INFLATION
1	0.081	0.007	99.993	0.000	0.000	0.000
2	0.099	0.440	95.515	0.019	0.021	4.005
3	0.107	2.641	90.993	0.219	0.639	5.508
4	0.118	6.287	84.171	1.000	3.332	5.209
5	0.141	9.390	74.008	2.255	10.317	4.029
6	0.189	9.898	61.209	3.691	22.667	2.535
7	0.290	7.952	48.479	4.916	37.345	1.308
8	0.494	5.427	38.610	5.698	49.680	0.585
9	0.894	3.526	32.127	6.096	58.007	0.244
10	1.673	2.364	28.140	6.275	63.120	0.101

Note: GDP= Real Gross Domestic Product; EDUC= Government education expenditure (% GDP); LE=Life Expectancy at Birth; BROAD= Broad money (% GDP); INFLATION= Inflation rate.

As we can see from Table 9, economic growth is mainly explained by its own innovation (48.37%) and the innovative shocks of the government education expenditure (34.66%). This confirms the causality relationship from government education expenditure to economic growth in Côte d'Ivoire. Furthermore, while focusing on the Variance Decomposition of EDUC, we can see that only 4.79% of the government education expenditure is explained by the innovative shocks of economic growth. This seems to validate the absence of causality from economic growth to government education expenditure in Côte d'Ivoire.

4.5. Discussion of the results and policy recommendations

Our results show that in the long term, government expenditure in education has a negative effect on economic growth. In the short term, the effect is positive but non-significant. This suggests that government expenditure in education do not contribute to increase economic growth in Côte d'Ivoire. This is quite astonishing but our result is consistent with some previous empirical results. Vijesandran and Vinayagathasan (2014) found that the relationship between education and economic growth is negative in the long run in Sri Lanka. Ndiyo (2007) and Nurudeen and Usman (2010) found a negative effect of Nigerian's public expenditure in education on economic growth. Nketiah-Amponsah (2009) showed that there is no relationship between public education expenditure and growth for Ghana.

We justified the negative effect observed in our study by the low level of public education expenditures and the inefficiency with which these expenditures are converted into human capital stock which is necessary to economic growth. Indeed, a brutal nosedive of Ivoirian's government expenditure devoted to education in the middle of the 90s is observed (See Fig. 1). The government expenditure on education stands in average at 7% of GDP from 1970 to 1993 and fell at 4.2% of GDP from 1994 to 2015. Moreover, the inefficiency with which the education expenditures are converted into educational human capital stock could be explained by the different crisis that Côte d'Ivoire faced in the past which negatively attempt to the educational system of the country. Accordingly, the negative relationship between government education expenditure and economic growth may also be explained by the quality of education. Indeed, while education expenditures are not of quality, this could translate into the quality of education itself, and thus, lower the economic growth.

Yet, the causality relationship from government education expenditures from economic growth warms on the fact that policies aiming to invest more in education are important for more production. Say differently, investing in education sector determines economic growth. We thus recommend an increase in the government education expenditures. However, although the amount of government education expenditures should be increased, these expenditures must be of quality. What is also important is the efficiency with which they are translated in education outcomes through better ratios of education. For example, Benin spends relatively less than Côte d'Ivoire in term of education expenditure, but the rate of pupils enrolled in primary education is high in that country than in Côte d'Ivoire. By doing this, one should expect that not only the recent high economic trajectory will be improved, but also it may results in more inclusive growth.

Another explanation that we have about the negative effect of government education expenditure on economic growth is that the expenditures is oriented towards unproductive expenditure. To comfort this argument, we follow a World Bank (2016) report which states that more than 80% of the Côte d'Ivoire Ministry of Education are devoted to the payment of teachers' salaries. Thus, one recommendation to the Ivoirian government is that the education expenditure must be oriented towards productive expenditure such as the construction of more educational institutions, the renovation of the existing education facilities and the construction of new and adequate learning facilities.

5. Conclusion

The objective of this paper is to provide some empirical evidence for the relationship between government education expenditure and economic growth in Côte d'Ivoire while controlling for some socio-economic variables. With that in mind, we gather data from 1970 to 2015 and apply the Pesaran et al. (2001) bounds testing approach, estimate an ARDL model to deal with the short and long runs relationship and use the Toda and Yamamoto (1995) causality test. The results show that there is no short term effect of government education expenditure on Côte d'Ivoire's economic growth. However, we were able to exhibit the presence of a long term relationship between the two variables. Surprisingly, the effect of government education expenditure on economic growth is negative in the long term. We test the robustness of this result by using the Fully Modified Ordinary Least Squares (FMOLS). The low level of government education expenditures and the inefficiency with which these expenditures are converted into human capital stock appear to be the main possible explanation of our results.

The socio-economic control variables effects on economic growth are stated as follows. We find positive effects of life expectancy at birth and broad money on economic growth in the long term. However, the

short term effects appear to be non-significant. Besides, inflation does not significantly impact on economic growth in short term and long term. Nevertheless, when the FMOLS is used, the effect of inflation on Côte d'Ivoire's economic growth is negative and significant.
Regarding the causality test result, we found that government education expenditure causes economic growth in Côte d'Ivoire. That result is supported by the variance decomposition method and suggest that policies aiming to invest more in education are important for more production.
From a public policy view, we recommend to increase government education expenditure towards productive expenditures such as the construction of more educational institutions, the renovation of the existing education facilities and the construction of new and adequate learning facilities.

References

Abubakar, A. B., & Abdulkadir, R. A. (2015). Education Expenditure and Economic Growth of India: An Econometric Investigation. *AIJBSR (Special issue)*.

Al-Yousif, Y. K. (2008). Education Expenditure and Economic Growth: Some Empirical Evidence from the GCC Countries. *The Journal of Developing Areas, 42*(1), 69-80.

Barro, R. J. (1991). Economic growth in a cross section of countries. *Quarterly Journal of Economics, 106*(2), 407–443.

Becker, G. S. (1964). Human capital theory. *Columbia, New York.*

Benhabib, J., & Spiegel, M. (1994). The role of human capital in economic development: Evidence from aggregate cross-country data. *Journal of Monetary Economics, 34*(2), 143–174.

Benos, N., & Zotou, S. (2014). Education and Economic Growth: A Meta-Regression Analysis. *World Development, 64*, 669–689.

Bosupeng, M. (2015). Payoffs of Education Expenditure In Botswana: Long Run Economic Growth Implications. *Journal of Applied Economics and Business Research, 5*(2), 85-96.

Browns, R., Durbin, J., & Ewans, J. (1975). Techniques for testing the constancy of regression relations overtime. *J. R. Stat. Soc, 37*, 149–172.

Browns, R., Durbin, J., & Ewans, J. (1975). Techniques for testing the constancy of regression relations overtime. *J. R. Stat. Soc., 37*, 149–172.

Devarajan, S., VinayaSwaroop, & Heng-fuZou. (1996). The composition of public expenditure and economic growth. *Journal of Monetary Economics, 37*, 313 344.

Douanla, T. L., & Abomo, F. M. (2015). Government spending in education and economic growth in Cameroon:a Vector error Correction Model approach. *MPRA Paper No. 62008*, 13p.

Eggoh, J. (2009). Croissance économique et développement financier : éléments d'analyse théorique et empirique. *Thèse soutenue le 1er Juillet 2009, Université d'Orléans*, 421p.

Eggoh, J., Houeninvo, H., & Sossou, G. A. (2015). Education, health and economic growth in African countries. *Journal of Economic Development, 40*(1), 93-111.

Granger, C. (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. *Econometrica, 37*(3), 424-438.

Idrees, A. S., & Siddiqi, M. W. (2013). Does Public Education Expenditure Cause Economic Growth? Comparison of Developed and Developing Countries. *Pakistan Journal of Commerce and Social Sciences, 7*(1), 174-183.

Jiang, Y., Shi, X., Zhang, S., & Ji, J. (2011). The threshold effect of high-level human capital investment on China's urban-rural income gap. *China Agricultural Economic Review, 3*(3), 297-320.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *J Econ Dyn Control*, 231–254.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inferences on cointegration with applications to the demand for money. *Oxford Bull Econ Stat, 52*, 169–210.

Mallick, L., & Dash, D. P. (2015). Does Expenditure on Education Affect Economic Growth in India? Evidence from Cointegration and Granger Causality Analysis. *Theoretical and Applied Economics, 22*(4), 63-74.

Mallick, L., Das, P. K., & Pradhan, K. C. (2016). Impact of educational expenditure on economic growth in major Asian countries: Evidence from econometric analysis. *Theoretical and Applied Economics, 2*(607), 173-186.

Manafi, I., & Marinescu, D. E. (2013). The Influence of Investment in Education on Inclusive Growth - Empirical Evidence from Romania vs. EU. *Procedia - Social and Behavioral Sciences, 93*, 689 – 694.

Mehmet, M., & Sezer, S. (2014). The effect of education expenditure on economic growth: The case of Turkey. *Procedia - Social and Behavioral Sciences, 109* , 925-930.

Mekdad, Y., Dahmani, A., & Louaj, M. (2014). Public spending on education and Economic Growth in Algeria: Causality Test. *International Journal of Business and Management, 2*(3), 55-70.

Musila, J. W., & Belassi, W. (2004). The Impact of Education Expenditures on Economic Growth in Uganda: Evidence from Time Series Data. *The Journal of Developing Areas, 38*(1), 123-133.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied Economics, 37*, 1979–1990.

Narayan, P., & Smyth, R. (2005). Electricity consumption, employment, and real income in Australia: evidence from multivariate Granger causality tests. *Energy Policy, 33*, 1109-1116.

Ndiyo, N. A. (2007). A Dynamic Analysis of Education and Economic Growth in Nigeria. *The Journal of Developing Areas, 41*(1), 1-16.

Nketiah-Amponsah, E. (2009). Public spending and economic growth:evidence from Ghana (1970–2004). *Development Southern Africa, 26*(3), 477-497.

Nurudeen, A., & Usman, A. (2010). Government expenditure and economic growth in Nigeria, 1970–2008: A disaggregated analysis. *Business and Economics Journal, 2*, 1-11.

Omojimite, B. U. (2010). Education and Economic Growth in Nigeria: A Granger Causality Analysis. *African Research Review, 4*(3a), 90-108.

Owusu-Nantwi, V. (2015). Education Expenditures and Economic Growth: Evidence from Ghana. *Journal of Economics and Sustainable Development, 6*(16), 69-77.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics, 16*(3), 289-326.

Pesaran, M., & Shin, Y. (1999). An autoregressive distributed lag-modeling approach to cointegration analysis. *In: Strom, S. (Ed.), Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium. Cambridge University Press, Cambridge (Chapter 11).*

Prontzas, P., Tsamadias, C., & Papageorgiou, P. (2009). Public Education Expenditures and Growth in Greece over the period 1960-2000. *SPOUDAI, 59*(1-2), 125-141.

Raheem, I. D., Isah, K. O., & Adedeji, A. A. (2018). Inclusive growth, human capital development and natural resource rent in SSA. *Econ Change Restruct, 51*, 29–48.

Sunde, T. (2017). Education Expenditure and Economic Growth in Mauritius: An Application of the Bounds Testing Approach. *European Scientific Journal, 13*(22), 70-81.

Tandi, L. (2013). Education as a key factor of smart and inclusive growth-The changing education policy of Hungary compared to Europe 2020 strategy. *Management, Knowledge and Learing International Conference 2013*, 765-770.

Toda, H., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *J Econometr, 66*, 225–250.

Vijesandiran, S., & Vinayagathasan, T. (2015). Dynamic relationship between human capital and economic growth in Sri Lanka; : A co-integration analysis. *Asian Online Journal, 2*(2), 20-29.

Wadad, S., & Kalakech, K. (2009). The Nature of Government Expenditure and its Impact on Sustainable Economic Growt. *Middle Eastern Finance and Economics, 39*(45), 39-45.

World Bank. (2016). The race to emergence : why Côte d'Ivoire must adjust its financial system. *Cote d'Ivoire economic update. Washington, D.C. : World Bank Group*.

Yildirim, N., Deniz, H., & Hepsag, A. (2011). Do public education expenditures really lead to economic growth? Evidence from Turkey. *International Research Journal of Finance and Economics, 65*, 13-24.

Zivot, E., & Andrews, D. (1992). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *J. Bus. Econ. Stat., 10*(3), 251–270.

Zoran, T. (2015). Analysis of the Impact of Public Education Expenditure on Economic Growth of European Union and BRICS. *Economic Analysis, 48*(1-2), 19-38.