



## MECHANISMS OF THE INFLUENCE OF HUMAN CAPITAL ON ECONOMIC GROWTH: A PANEL DATA ANALYSIS OF THE CEMAC REGION

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### ABSTRACT

*This paper examines the mechanisms through which human capital influences economic growth in the CEMAC region. The effect of human capital on economic growth was estimated using Two Stage Least Square (2SLS) multiple regression model for the individual countries and the method of Generalized Least Square for the whole sub region. The results show that secondary education improves human capital development. A good health system strengthens/increases the quality of capital. Knowledge acquired on the job increases the productivity of the workers and the accumulated human capital significantly impacts positively on the economic growth of the CEMAC region.*

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**Keywords:** Human Capital, Economic Growth, Education, Health, CEMAC region, Panel Data.

**JEL Classification:** I18, I28, N37, O47

### 1. INTRODUCTION

The debate on the economic growth of Africa gained momentum about 2003. Africa recorded a high growth rate while developed countries' growth stagnated with some countries recording zero rates of growth. After experiencing stagnating growth for some period of its post-colonial history, Africa recorded an improvement in its economic performance in the last decade as its GDP increased from an average of 5.6% annually for the period 2002-2008 putting this region in the second position in the world after East Asia. After the world financial crisis, the continent continued to grow. Amongst the 15 fast growing economies in the world in 2010, ten of them were

from Africa which is henceforth considered as a new growth region of the world. The above trend is equally observed in the CEMAC zone. Between 2007 and 2011, the average growth rate of the sub-region stood at 4.85% (World Development Indicator, 2012). The year 2009 was the most difficult since the return of growth in the continent in 2000. The rate of growth stood at 1.88%. During this same year growth was negative in Gabon and Chad with growth rates of -1.11% and -1.2% respectively. This rate is low in Cameroon, Equatorial Guinea and the Democratic Republic of Central Africa. Congo stood out as the fastest growing economy of the sub-region with a growth rate of 6.7%. In 2011, the progressive expansion of the world economy, increased export of raw materials and foreign direct investments contributed to the growth of the sub-region by about 6.76% far above the African average.

The rapid growth of Africa in general and the CEMAC region in particular calls into question the problem of the sources of growth of this region of the world. A good number of studies (Ajakaiye *et al.*, 2006; Ndulu *et al.*, 2007; McKinsey Global Institute, 2010) conclude that the growth of Africa is based on non-renewable natural resources and the exportation of primary materials. This makes the African economy that of rent and not of production.

Based on this, the economic commission for Africa observed that growth in the CEMAC region is non-inclusive. The economies of the sub-region still remain vulnerable to external shocks that result from the functioning of the world economy. This necessitates the transformation of resources and economic diversification which should be studied. For the CEMAC region to sustain its growth, it is important to analyse the principal sources of growth which stimulate the process of production in the context of restructured economy (Mankiw *et al.*, 1992). According to the endogenous growth theory, human capital together with physical capital remains the principal sources of growth. They enable economies to grow rapidly. For example, it is shown that the enrollment rate into secondary school in Gabon and in Congo in 2010 was 53.1% and 44.6% accompanied by a growth rate of 6.7% and 9.7%. Generally, there exists a strong correlation between investment in human capital and growth. Also, life expectancy has improved in the sub-region. In 1960, it was 40 years in Cameroon and increased to 51 years in 2011. For the same period, it increased from 52 years to 62 years in Gabon close to that in developed countries which stand between 70-75 years. Improvement in health systems, vaccination campaigns and progress in medicine greatly account for this trend. In this connection, four countries (Cameroon, Congo, Gabon and Equatorial Guinea) improved their positions on the classification table of the human development index. In 1980, Cameroon had a human development index of 0.37 which increased to 0.482 in 2011. Gabon's situation improved from 0.522 in 1980 to 0.674 in 2011. This index increased from 0.465 and 0.488 in 1980 to 0.533 and 0.537 in 2011 in Congo and Equatorial Guinea respectively. This shows that in 2011 three countries were above half of this index. This good performance is explained by an improvement in the health system despite the persistence of poverty and income inequality in the sub-region.

Generally, all the countries of the CEMAC region adopt well defined and documented policies to fight poverty, increase the human development index and to move towards realizing priority

millennium development goals. Besides educational factors such as enrollment rates into primary and secondary schools, or public and private expenditure on education, human capital includes health situation generally measured by life expectancy at birth, fertility and human mobility or migration.

Against this background, this paper sets out not to investigate the relationship between human capital and economic growth per se. It seeks to examine the mechanisms through which human capital influences economic growth in the CEMAC sub-region. This being the case, while investigating the relationship between human capital and economic growth in the sub-region, the paper establishes through the method of interactive variables the mechanisms through which human capital contributes to growth in the sub region. The rest of the paper is presented as follows. Section two reviews both the theoretical and empirical literature on human capital and growth. Section three discusses the method of analysis. The results are presented and discussed in section four. Section five concludes the paper with some policy recommendations.

## 2. LITERATURE REVIEW

### 2.1. Theoretical Literature

#### 2.1.1. The Concept of Human Capital

The concept of human capital dates back to classical economics and later developed into a theory (Fitzsimons, 1999). This led Schultz (1961) to consider human capital as one of the most important factor of economic growth while Alexander (1996), Grubb and Marvin (2004) and Sen (1999) showed that human capital contributes to socio-political development and freedom.

The concept of human capital is viewed in a number of ways. Firstly, Schultz (1961) links it to property in the form of skills and knowledge possessed by individuals. This view is extended to include knowledge, skills, education and abilities (Youndt, 2004). Also, Rastogi (2002) considers human capital to include Knowledge, competency, attitude and behavior of individuals. Secondly, De la Fuente and Ciccone (2002) consider human capital as knowledge and skills obtained through general education and vocational training. This view neglects the experience people acquire through out life. A third perspective considers human capital as the main source of economic activity (Romer, 1990). In this connection Rosen (1999) sees human capital as an investment on people to increase their productivity. Frank and Bernanke (2007) see human capital as a whole set of factors including; education, training, experience, energy and worthiness that influence additions to workers' output. This view leads Sheffrin (2003) to conclude that human capital is a stock of skills and knowledge which manifest in the ability of labour to perform better. Equally, Rodriguez and Loomis (2007) conceive human capital as the knowledge, skills, competencies and attributes of individuals that make it easy for them to create personal, social and economic wellbeing. From the above, human capital includes skills and competencies acquired through education, training and life experiences.

Human capital is characterized in a number of ways. Crawford (1991) holds that unlike ordinary labour, human capital is expandable, self generating, transportable and shareable. It is

expandable and shareable in the sense that the stock of knowledge increases the individual's human capital as original knowledge and continuously elaborated and developed. Also, human capital is transportable and shareable in the sense that the original holder of knowledge has the possibility of sharing this knowledge with others.

Human capital affects the individual worker, the organization and the economy as whole. To the individual worker it increases his/her income due to increase productivity. He or she is preferred by employers and stands the chance to move to a higher level in the organizational hierarchy (Sicherman, 1991). The human capital of individual workers influences the level of competences and competitiveness of an organization as well as organizational routines, cultures and relational capital (Lepak and Snell, 1999). At the societal level, the influence of human capital on the individual worker and the organization culminates in an increase of social consciousness which leads to socio-political development (Alexander, 1996; Grubb and Marvin, 2004; Beach, 2009).

Human capital can be categorized into general, firm specific and task specific. To Becker (1964) knowledge and skills of workers accumulated through education and experience constitute general human capital on the one hand and on the other hand there is firm /task specific human capital which is acquired through education, training and work experience and is scarcely applied in other firms/industries and tends to increase productivity only at a given firm (Becker, 1964).

Human capital is captured in terms of output, cost and income. The output measure of human capital includes elements such as school enrollment rate, school attainment, adult literacy, average years of schooling etc. In terms of cost, human capital is measured as the cost incurred to obtain knowledge while the income approach to human capital considers the benefit individuals get from education and training (Mulligan and Sala-i-Martin, 1995). Hanson (2008) observes that OECD countries jointly consider investment in human capital, quality adjustments and results of education as a measure of human capital. However, this view is criticized on the ground that it neglects some capital accumulating factors such as social capital (Winkler, 1987; Coleman, 1988; McMahon, 1998; Schuller, 2001). To overcome the above demerits, Coleman (1988) suggested that the human development Index (HDI) which is built on the bases of knowledge, health, standard of living and many other sub-variables could be used as a proxy for human capital.

### 2.1.2. The Fundamental Theory of Human Capital

Lucas (1988) provides a basis for the understanding of the role of human capital in economic growth and the explanation of the differences in the growth of nations in a context where the cost of education and training is inversely related to the level of development of a country. Countries with low human capital development (LDCs) are characterized by rapid population growth while those with an initial high stock of human capital keep on intensifying education and training.

Human capital of an individual or population as earlier defined includes theoretical and practical knowledge, competencies and qualifications as well as the state of health of the individual or population. The inclusion of human capital as one of the factors in the endogenous growth model

was first proposed by Lucas (1988), though Denison (1962) had earlier introduced education as a factor in this model.

In an endogenous growth model, human capital is expected to have a similar effect to that of physical capital. The effect of human capital on growth is felt through two principal channels. Firstly, the quantity of physical capital is positively related to the active population. Secondly, the efficiency of labour and GDP increases with an increase in human capital development. When human capital and physical capital work together, there is increasing returns to scale which originate from an external source or from within the organisation. To this end, Lucas (1988) introduced human capital into the production function as follows

$$N(t)c(t) + \dot{K}(t) = AK(t)^\beta [u(t)h(t)N(t)]^{1-\beta} h(t)^\gamma \quad (2.1)$$

Where N represents the number of workers, c consumption per head, K quantity of capital,  $\dot{K}$  accumulation of capital, A technical progress, u time devoted to work, and h human capital. Simply, we can reformulate the model in (2.1) to a growth model of the type  $AK^1$  to have:

$$Y = K^\alpha (hL)^{1-\alpha} \quad (2.2)$$

Where h represent human capital per head. Lucas assumes that human capital increases as indicated in the following equation:

$$\dot{h} = (1-u)h \quad (2.3)$$

Where u is time devoted to work and (1 – u) time devoted to training. It is seen that the time devoted to training increases the rate of growth of human capital.

$$\frac{\dot{h}}{h} = 1 - u \quad (2.4)$$

And h is included in the production function in the same way that technical progress increases productivity in the Solow's model. This model works as the Solow's model but with A being human capital and  $g = 1-u$ . Any policy which increases continuously training time increases in a similar way the rate of growth of GDP per capita.

From the foregoing we can explain the disparities amongst countries of the world. The more developed the level of human capital, the higher the marginal productivity of capital and this moves physical capital towards the developed countries. Such a movement of capital accentuates the disparities amongst nations contrary to the convergence predicted by the neoclassical models.

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<sup>1</sup>The explanation of the AK model was first used by Romer, P.M., 1990. Endogenous technological change. *Journal of Political Economy*, 98(5): 71-102, Aghion, P. and P. Howitt, 2010. *L'économie de la croissance*, Economica, Paris.

## 2.2. Empirical Literature

There exists a strong relationship between human capital and economic growth. As an investment, it increases the total product. In fact, human capital is considered as the whole set of productive capacities that an individual acquires in the form of accumulated general or specific knowledge. To (Becker, 1964), it is made up of activities in the form of investment. Conclusions of the model of human capital underscore the fact that well trained workers, or those who have attained a very high level of education are the most productive. From all indications, human capital is an investment. The factors which influence investment in human capital are age of the individual, the cost of education and salary differential between different levels of education.

Considering the studies of Tatlah *et al.* (2011) on the role of human capital and education on economic growth, we see that spending on education remains the main investment on human capital on the one hand and the later contributes to growth on the other hand. To this end, in Uganda Barro (1991) shows that public and private spending on education and training received by the youth influence positively the quality and quantity of output of enterprises and consequently increases economic growth. However, this influence is seen to be more important in the case of public spending on education than private spending. Really, public investment on education is not only limited to the recruitment of teachers and paying them. It also involves expenditure on infrastructure such as building laboratories etc.

Meanwhile Keramat and Safdarie (2012) consider human capital as a pre-requisite for development because the rate of economic growth and development depends on the quality and quantity of labour force. On the study of the influence of human capital on economic growth in Iran, they used the endogenous growth model proposed by Lucas (1988). Besides human capital measured by the rate of enrollment into the University, the authors include in their model physical capital, and non petroleum exports. They show that a 1% increase enrollment of students in the University increases economic growth by 0.29%. Akbari *et al.* (2012) found the same results with human capital increasing economic growth by 0.44% in the long-run.

Amir *et al.* (2012) in their study provided evidence on the effects of human capital on economic growth in Pakistan for the period 1980-2010. Human capital is found to be associated to technological development and the Romer (1990) model was used in the methodological framework and human capital is measured by the enrollment rate into secondary school a variable which is commonly used (Barro, 1991; 2003). They found in the short-run that human capital accounts for 4.1% economic growth of Pakistan. However, in the long run this influence became negative due to the political instability of the country in the 2000s which forced trained workforce to emigrate from the country. This shows that the actual effect of human capital on economic growth depends on the political as well as the social atmosphere of the country.

Aghion and Cohen (2004) equally used panel data for 110 countries for the period 1960 to 2000 to investigate the effect of human capital on growth. Approximating human capital by years of schooling by the active population, they show that human capital affects positively economic growth. Also, the influence of human capital on the fixed effects of convergent regression was

established by [Haldar and Mallik \(2012\)](#). After constituting an interactive variable between financial development and human capital, he shows that the later reinforces growth in the long-run.

The contribution of human capital to growth is also seen through technical progress. In fact human capital is a pre-requisite in research and development which makes possible the production of new products. Recent literature on growth throws more light on the relationship between human capital and economic growth through growth models based on research development ([Grossman and Helpman, 1990](#); [Romer, 1990](#)). They emphasize the importance of human capital linked to research in the process of innovation and economic growth. [Pissarides \(1997\)](#) extended the model of [Romer \(1990\)](#) by taking into consideration the importance of the process of imitation. According to this approach, human capital ensures a sustained increase in production in Less Developed Countries (LDCs) through technological development.

It is important to observe that the experience of the emerging countries of Asia seem to tie with the teachings of this approach. The availability of a qualified workforce allows for a change in the techniques of production which through imitation and innovation contributed to the economic growth of these countries. The improvement in the trend/structure of exports in South Korea and Taiwan was due to a qualified manpower linked to improvement in technical progress.

However, some studies show a negative relationship between human capital and growth<sup>2</sup>. This has been attributed to measurement problems of human capital and implementation problems of public policies to improve the level of human capital development. Considering the effects of innovation and of human capital on economic growth in Iran between 1975 and 2008, [Safdari et al. \(2012\)](#) focused on the long term relationship between human capital and growth. They found a stationarity at the level of explanatory variables in a VAR model on the one hand and a significant negative influence of human capital on growth on the other hand. In fact, they show that about 3% growth is lost in Iran when specialized human capital is taken into consideration.

From the above review of literature, emphasis is on the association between human capital and economic growth. It neglects to a larger extent the channels through which human capital impacts on economic growth. This is the focus of the current paper.

### 3. METHODOLOGY

Based on the theoretical and empirical works of [Lucas \(1988\)](#), [Barro \(1991\)](#), [Aghion and Cohen \(2004\)](#), [Tatlah et al. \(2011\)](#), [Keramat and Safdarie \(2012\)](#) and [Amir et al. \(2012\)](#), we selected a good number of variables related to human capital which have an impact on economic growth. Table 1 below describes the variables of the study together with the expected signs of their coefficients. From [Barro \(2003\)](#), we include in the model the number of enrollment in primary and secondary education. We also add the health factor measured by life expectancy at birth. It is assumed that the more the population benefits from a good health system, its productivity increases.

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<sup>2</sup>Alan, K.M.A., Y. Altman and J. Roussel, 2008. Employee training needs and perceived value of training in the pear river delta of China: A human capital development approach. *Journal of European Industrial Training*, 32(I): 19-31.



Amongst the variables that describe human capital, a number of studies have included public spending on education and health on the one hand and on the other adult literacy rate. These very important variables are not included in this study because of absence data for them does not exist for a sufficiently long period. Despite this difficulty, this paper still contributes to explain the influence of human capital on economic growth in the CEMAC region.

Hence, besides the two traditional variables used (education and health), we added two interactive variables (EDU\*Health and EDU\*L). The first variable shows that good education and training per se does not guarantee returns from schooling. It is important to ensure a good health system in the country to reinforce this trained manpower.

The second interactive variable (EDU\*L) captures the effective entry of trained youths into the labour market. The early the youths gain employment after leaving school, the early they start contributing to the creation of wealth and by implication to economic growth. In fact this variable plays a significant explanation in the way human capital influences economic growth in the CEMAC region. A good health system and a well structured labour market are very important conditions which make it possible for human capital to contribute to economic growth.

The dummy variables in this study measure the level of development of the country. It takes 0 slightly below middle and low income countries and 1 for slightly above middle and high income countries. Its aim is to check if the level of the development of the country can influence the contribution of human capital to economic growth. This is in a bit to ensure that at the end of the study good policy recommendations are made to the leaders of the CEMAC region.

New theories on economic growth put more light on these doubtful areas by providing possible answers to the exact origin of technical progress. The model generally used by these theories is the AK model:

$$Y_{it} = A_{it}^{1-\alpha} * K_{it}^{\alpha}, \quad (3.1)$$

$0 < \alpha < 1$  Where  $A_{it}$  is a productivity parameter attached to the most recent technology used in the industry  $i$  at a given time  $t$ . In this equation,  $K_{it}$  represents all forms of capital. The main models include: (1) [Romer \(1986\)](#) with the accumulation of knowledge, (2) [Lucas \(1988\)](#) which is based on the importance of human capital, (3) [Romer \(1990\)](#) which is based on research and development (R & D), (4) the role of the state and infrastructures in the [Barro \(1990\)](#) and (5) [Aghion and Howitt \(1992\)](#) based on a destructive creation inspired from Schumpeter's model.

In this article, the theoretical/conceptual model of [Mankiw et al. \(1992\)](#) is used as follows:

$$Y = K^{\alpha} H^{\beta} (AL)^{1-\alpha-\beta} \quad (3.2)$$

Where 'K' is physical capital, 'H' human capital, 'A' technical progress and 'L' Labour:  $\alpha$ ,  $\beta$ , and  $(1-\alpha-\beta)$  represent, respectively, the elasticity of physical and human capital, labour and technical progress.



The model to be estimated is inspired by the works of [Aghion and Cohen \(2004\)](#), [Tatlah et al. \(2011\)](#), [Keramat and Safdarie \(2012\)](#) et [Amir et al. \(2012\)](#). It is specified as follows:

$$\text{Log}(\text{GDP} / \text{Capita})_{it} = \beta_0 + \beta_1 \text{Log}(L)_{it} + \beta_2 \text{Log}(K)_{it} + \beta_3 \text{Log}(\text{Health})_{it} + \beta_4 \text{Log}(\text{EDU} \_ \text{PRI})_{it} + \beta_5 \text{Log}(\text{EDU} \_ \text{SEC})_{it} + \beta_6 (\text{EDU} * \text{Health})_{it} + \beta_7 (\text{EDU} * L)_{it} + \beta_8 \text{DUMMY}_i + \varepsilon_{it}$$

Where  $\varepsilon_{it} = u_i + v_t + \eta_{it}$ ,  $u_i$  captures the specific individual effects,  $v_t$  the temporal specific effects

and  $\eta_{it}$  the rest of the disturbances

The variable education (EDU) combined with the variable health and labour takes into consideration both primary and secondary education especially where the young end their education and training at the primary and secondary level.

$$\text{EDU} = (\text{EDU} \_ \text{PRI}) * (\text{EDU} \_ \text{SEC})$$

The data covers the period 1985 to 2010. The starting point of the data takes into consideration the date of admission of Equatorial Guinea into the CEMAC region. Within this period all the countries of the sub region implemented policies to improve primary, secondary and even higher education. In Cameroon, Gabon, and Central African Republic primary education is free. The situation is even better in Equatorial Guinea and Chad where even higher education is free. With many vaccination campaigns, the health of nursing mothers and children is guaranteed and free for a good number of diseases.

After testing for the choice, between Panel data and OLS (Using Fischer-test) and choosing between Fixed and Random effects (Using Hausman-test), the two stages Least Square (2SLS) Method of estimation was used for the individual countries and the Generalized Least Square method for the aggregate model.

The construction of a correlation matrix of the dependent variable and independent variables shows a positive and relative significant correlation between the dependent and independent variables. It is observed that 0.14% economic growth is explained by physical capital. The variables primary education and secondary education have a positive relationship with economic growth contributing to 0.45% and 0.57% economic growth in the CEMAC region.

There is a low degree of correlation between the explanatory variables which shows the absence of multicollinearity. Averagely, the correlation between the variables is about 30%.

#### 4. PRESENTATION AND DISCUSSION OF RESULTS

The average trend of the data is summarised in Table 4 below.

**Table- 1.**Descriptive statistics

Variables	Cameroon	Congo	Gabon	Equatorial Guinea	CAR	Chad	Global model
Log	2.841	3.048	3.638	3.249	2.406	2.316	2.916
(GDP/Capita)	(0.063)	(0.034)	(0.033)	(0.492)	(0.041)	(0.090)	(0.505)
Log (L)	6.471	5.841	5.473	5.055	5.952	6.217	5.835
	(1.323)	(1.195)	(1.120)	(1.034)	(1.216)	(1.271)	(1.267)
Log (K)	8.188	8.897	9.127	6.360	7.786	8.482	8.140
	(3.018)	(0.265)	(0.103)	(3.994)	(1.595)	(0.550)	(2.312)
Log(Health)	1.644	1.676	1.713	1.616	1.601	1.628	1.646
	(0.335)	(0.342)	(0.349)	(0.330)	(0.327)	(0.332)	(0.332)
Log	8.802	8.091	7.657	7.277	8.163	8.542	8.088
(EDU_PRI)	(0.065)	(0.075)	(0.073)	(0.126)	(0.062)	(0.106)	(0.519)
Log	8.890	8.196	7.792	7.428	9.450	8.589	8.391
(EDU_SEC)	(0.095)	(0.098)	(0.101)	0.100)	(0.062)	(0.107)	(1.034)
Nbers of obs.	26	26	26	26	26	26	156

Source: Authors

Given the fact that we took the log values of the variables to linearise the model, a good interpretation of the descriptive statistic would warrant that we consider the exponential values. Based on this, it is observed that the average GDP per capita for the period 1985-2010 is 1634.88 USD ([World Development Indicator, 2012](#)). This average has been reduced by the poor performance of Chad and the Central African Republic which for this period recorded with difficulty 256.55USD and 211.81 USD of GDP per capita annually. Gabon stands in the first position with an annual GDP per capita of 4,366.40 USD. She is followed by Equatorial Guinea (3,152.16 USD). Cameroon and Congo find themselves in the middle position. In terms of gross enrollment rate into primary school, Congo comes in the first position with a rate of 119.5%. She is closely followed by Cameroon which in 2010 recorded an enrollment rate in the primary school of 113.8 % ([CEA-BSRAC, 2011](#)). Due to an aggressive educational policy, the state of Cameroon made primary education free in public primary schools. In fact, since 2000 pupils in primary schools are expected to pay only the Parent Teachers' Association (PTA) levy. This levy finances the payment of PTA teachers, construction of classrooms and purchase of office and didactic materials. State subventions are used to meet other expenses. Each year, about 17% of the state budget is used to finance the education industry (primary, secondary, and higher education) ([MINEFI, 2011](#)). Also, the policy of free primary education has been implemented in Congo. In this country, besides formal education, adult education has received a lot of attention. At the start of the 1980s only 1% of the adult population was literate. In 2010, this percentage rose to 35%. Generally, the variables witnessed a very low level of fluctuation considering their standard deviations which fluctuate around 0.31 with the exception of the factor labour. In fact, all the CEMAC countries suffer to different degrees from the problem of unemployment. Empirically, the results of our models are summarized in table 6 below.

Table- 2.Results of Estimations

Dependant variable : Log (GDP/Capita)							
	Cameroon	Congo	Gabon	Equatorial Guinea	CAR	Chad	Global model
Explanatory Variables	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	Random Effects
Log (L)	-0.763*** (0.226)	-0.632** (0.256)	-0.464** (0.170)	14.000*** (1.081)	-3.180*** (0.767)	-1.21* (0.630)	-1.33** (0.517)
Log (K)	0.003 (0.001)	0.056* (0.029)	0.224*** (0.037)	-0.003 (0.003)	-11.942*** (2.787)	-0.084 (0.094)	0.040*** (0.121)
Log(Health)	3.090*** (0.916)	2.235** (0.915)	1.512** (0.562)	-44.654*** (3.470)	-0.824** (0.377)	4.846* (2.492)	3.698*** (1.075)
Log (EDU_PRI)	-9.255*** (0.523)	0.886 (1.595)	0.574*** (0.158)	6.868*** (0.588)	2.018** (0.7110)	-12.882*** (3.385)	0.883*** (0.226)
Log (EDU_SEC)	7.245*** (0.654)	-0.240 (1.461)	-0.243 (0.209)	-10.466*** (1.268)	12.003*** (2.785)	14.882*** (0.000)	-0.029 (0.037)
EDU*Health	2.145 (0.124)	1.215* (0.014)	0.865** (0.064)	3.541** (0.124)	1.234* (0.854)	1.281* (0.124)	0.351* (0.053)
EDU*L	3.457* (0.271)	0.125** (0.351)	2.145*** (0.912)	2.021** (0.015)	1.234 (2.154)	0.958* (1.348)	0.107*** (0.031)
DUMMY							0.815** (0.327)
Cons	19.737*** (2.788)	-2.706 (2.112)	-0.964 (1.490)	32.464*** (5.463)	-14.269** (5.865)	-18.91** (6.838)	-4.542** (1.923)
NbersObs	26	26	26	26	26	26	156
F (8 ; 20)	107.27	34.84	18.17	867.13	35.61	12.05	
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
R-squared	0.9641	0.8970	0.8196	0.9954	0.8990	0.750	
Adj. R-squared	0.9551	0.8713	0.7744	0.9943	0.8738	0.688	
Wald Chi2 (8)							327.29
Prob>Chi2							0.0000

Source: Authors

Generally, the results present the significance of the different variables of human capital both for the disaggregated and the aggregate models. The health factor measured here by life expectancy at birth influences positively economic growth in four countries (Cameroon, Congo, Gabon, and Chad). In fact, an improvement in the health system or a better access of the population to health facilities reduces their vulnerability to sickness, and enables them to work harder. About 3.09 points of growth are gained by Cameroon due to improvement in the health system. Congo, Gabon and Chad gain 2.23, 1.51, and 4.84 points of growth respectively. These results are similar to those obtained by Barro (2003). This is explained by the policies implemented by the public authorities of the various countries amongst which we can cite: access to free treatment of malaria, free distribution of treated mosquito nets, vaccination of children of school going age and the free treatment of AIDS. If in all the countries of the CEMAC region, AIDS remains the main cause of death and of fall in productivity of workers, malaria also remains the principal cause of the death of children and even the youth. The harmonization of health policies within the sub-region improves the growth of the region by 3.69%.

The contribution of primary education to economic growth is not very high. It stands at 0.88%. A good number of reasons can explain this result. These reasons include: rampant repetition and school dropout, the young with only primary education are not well equipped to work and still needs more training to be able to produce the expected results. In the disaggregated models, negative results are obtained in Cameroon and in Chad. In Gabon, Equatorial Guinea and Central African Republic, we observe a significant contribution of primary education to economic growth of 0.57, 6.86, and 2.01 respectively. The training received at the primary level in these countries is seen to be the foundation of the training of the young. A good primary education forms a base for good performance at the secondary level. Secondary education in the CEMAC region has witnessed a number of changes within recent times. Besides, the creation of new secondary schools, professionalization has come to complement secondary general education. Different types of technical colleges including that for agriculture, tourism, and hotel catering and metal works have been created in Cameroon. The growth of this country can increase at the rate of 7.24% if enough effort is made in this direction. In the same way, Central African Republic, and Chad would benefit from these developments. In the aggregate model, the non-significance of secondary education is justified by the low rate at which the young school leavers at this level enter the labor market. The later find themselves in temporal jobs and in the informal sector when they fail to get decent jobs. Consequently, what they do influence very little the national output. This corroborates the results of [Tatlah \*et al.\* \(2011\)](#) and [Akbari \*et al.\* \(2012\)](#). Besides these results, the study seeks to show how human capital influences economic growth in the CEMAC Sub-Region. The first interactive variable is a combination between education and health (EDU\* Health). It is positive and significant in all the models except in Cameroon. This variable shows that a youth in good health works harder and contributes more to the production of goods and services. The CEMAC region would gain 0.35 points of growth if its health system improves by 1%. This impact is stronger in Equatorial Guinea where economic growth would increase by 3.54%. In Chad, the policy of free access to health influences economic growth by about 1.2%. This shows that efforts in modernizing the educational system should be accompanied by appropriate health policies where the state takes the responsibility of financing the treatment of a good number of sicknesses/illnesses. This should be the case in domains such as health of pregnant women, adolescents and children; fight against sicknesses such as AIDS, malaria, tuberculosis, diabetes and hypertension as well as promotion of health, and valorization of health units.

As concerns the second interactive variable, it captures the combination between labour and education (EDU\* L). It is used as a proxy for socio-professional inclusion. The final objective of education and training is to acquire theoretical and practical knowledge which facilitates entry into the labour market. In Cameroon, the effective integration or entry of the youth into the labour market would increase economic growth by 3.45%. For example, in Cameroon in 2012 the rate of economic growth stood at 5.1%. At this pace, if the policy of creation of enterprises and the effective employment of the youth continues, Cameroon can attain a growth rate of 8.55%. In Gabon and Equatorial Guinea, the same observation is made. The economic growth of these

countries would increase at 2.14% and 2.02% respectively. The untold rate of unemployment which prevails in Congo, Chad and the Republic of Central Africa compromises the contribution of the youth to economic growth of these countries. On the average, the rate of economic growth of these countries improve only by 0.766% .This reduces the contribution of this factor to the growth of the sub-region .The CEMAC region gains only 0.107% points of growth from the employment of the youth. As indicated above, the dummy variable captures the effects of economic development on human capital. Its positive sign and significance shows that the more a country is economically developed the higher the level of its human capital development and consequently the more its human capital contributes to economic growth. The dummy variable took 1 for Gabon and Equatorial Guinea and 0 for the other countries of the sub-region.

## 5. CONCLUSION AND POLICY IMPLICATIONS

This study aimed at examining the mechanisms of the influence of human capital on economic growth in the CEMAC region. Data for the study was collected from the World Development Indicators (WDIs) databank covering the period from 1985 to 2010. The descriptive results assessing the evolution of growth and other indicators in the sub region show that the average GDP per capita for the period of the study stood at 1634.88USD. There is evidence that there is a high rate of enrollment into primary school in the sub region with Congo to ping the chart with an enrollment rate of 119.5%. In terms of adult education, there has been an improvement in the adult literacy rate in the sub region, for example, the rate increased from 1% in 1980s to 35% in 2010 in Congo. Unemployment still remains a problem in the region. On the whole the factors of growth considered in addition to human capital portray a low level of fluctuation.

Empirically, the effect of human capital on economic growth was assessed by estimating a multiple regression model using Two Stage Least Square (2SLS) for the individual countries and the method of Generalized Least Square for the whole sub region. The empirical results show that human capital including the interactive variables have to a larger extent a positive and statistical significant effect on economic growth in the CEMAC sub region.

From a policy perspective, we propose two sets of recommendations relating to the sub region as a whole and to the individual countries. At the sub regional level, the following strategies can be used to boost growth in the sub region.

- i) Emphasis should be put on secondary education. Given that its low contribution to growth is due to its theoretical nature, it should be increasingly professionalized and the youth should be educated and sensitized on the importance of technical, commercial and vocational training. At this level of education, entrepreneurship could be included in the study programme such that youths who fail to join the labour market at the end of their studies or to persue further education can conveniently create jobs for themselves.
- ii) There is need for an increase in public spending on health to take care of health problems of those even in the hinterlands. This policy should also take care of health complications linked to particular occupations and work places.

iii) For a better coverage of health problems in the sub region, a common strategy should reinforce the efforts of individual governments.

iv) The diversification of the economies of the sub region should be considered as a veritable strategy to significantly reduce unemployment.

At the level of individual countries, the following strategies could be adopted:

i) There is need to improve access to health systems in Equatorial Guinea and the Republic of Central Africa.

ii) The governments of Cameroon and Chad should continue to improve on their policy of free primary education. Though the contribution of this level of education to growth was low, it should be improved since it forms the foundation of subsequent training.

iii) There is need for professionalization of secondary education in Congo, Gabon and Equatorial Guinea.

iv) Promotion of entrepreneurship should be the preoccupation of all the countries of the sub region so as to encourage the creation of enterprises which can absorb the unemployed.

Meanwhile the significance of the interactive variables (education and health; education and labour) points to the importance of the other factors that enhance the productivity of labour. At the CEMAC sub regional level and at the level of individual governments ways should be sought to continuously improve the efficiency of these labour productivity enhancing factors.

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