Human capital and economic growth in Algeria: impact study (1990-2018)
-ARDL approach-

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Summary: Through our research we tried to highlight the role of human capital at driving economic growth through measuring the influence of education and health on the GDP.
In order to reach our objective, we used the bound cointegration technique (Autoregressive Distributed Lag (ARDL) cointegration technique) to estimate the long run relationship and to analyze the implication of the human capital on the economic growth in Algeria during the period 1990-2018.

 As a result, we figured out a significant positive long run relationship between the human capital which is represented by mean years of schooling as a proxy for the education variable and life expectancy at birth as a proxy for the health variable and the economic growth represented by the GDP where a 1% increase in the mean years of schooling and life expectancy at birth variables will increase GDP by 0.2%, 2.1% respectively.

Keywords: human capital; economic growth; education; health
Jel Classification Codes: O15, I29

I- Introduction :

Human capital is one of the most fundamental and crucial criteria that measure the wealth and progress of nations. Most experts in nowadays regard it as one of the most productive elements that can contribute to development. Human capital through minds, ideas and trained labor accumulated over time has been credited with most of the successes achieved by many countries on the social and economic level. An addition to the material resources, the human element seeks to manage and optimize these resources for maximize the economic growth.

By analyzing the role of the human element in supporting the economic growth, we can extract the importance of the investment in the human capital through the expenditure on education and training and the level of social and health services that maintain this human wealth. Thus, human capital is the stock of the healthy, educated and productive population that owns any country, which is a major factor in determining and enforcing the economic growth and promoting the human development.

The concept of human capital has been used frequently in economics for at least thirty years (eg Schultz, 1961 Becker, 1964); some go back to the work of Adam Smith in the eighteenth century. This concept focuses on the importance of human capital in the economies based on knowledge and skills[1].

The fundamental hypothesis that constitutes the heart of the theory of human capital according to Mincer, Becker and Schultz is that education is an investment (for individuals and society) that increases the productivity of those who receive it and increases their earnings. (Becker, 1964), think that training, whether general or specific to determined tasks, affects positively the

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productivity of individuals by improving their general skills and knowledge by providing them with qualifications directly or potentially applicable to the production process[2].

The Pioneers of the theory of human capital confirm that the human capital has a positive impact on economic growth, furthermore, Schultz believe in the idea of educational capital as part of the concept of human capital, which is concerned with improving and investing in education and he studied the reasons that allowed Germany and Japan after World War II to achieve a miracle recovery from a destructive widespread, Schultz concluded that the fast recovery belong to higher education and healthy population, so his conclusion was that the education and the good health make people more productive[3].

As any country in the world, Algeria aims to achieve high rates of economic growth by supporting the various sources of GDP growth in general and human capital in particular by supporting and reforming education and health sectors.

According to the above, the basic problem of this research can be posed by the following question:

How does human capital affect economic growth in Algeria?

The importance of the study is to measure the extent of the contribution of human capital through education and health to the growth of the economy in Algeria, by clarifying the importance of both health and education and the role of investment in them in employment and the effective exploitation of knowledge and competencies in raising the internal product and thus increasing economic growth.

In order to achieve our study we applied an econometric study using ARDL model where the economic growth is the dependent variable represented by the GDP and the human capital through education and health as independent variables.

I.1. The previous studies:
A lot of academic studies and experiences have been achieved in order to measure and clarify the impact of human capital on the economic growth; there are some of recent literature reviews:
Mousaoui Mohamed[4], the Impact of Investing in Human Capital on Economic Growth: A Case Study of Algeria: This study aimed to determine the extent to which spending on education and the number of those enrolled in education contribute to the real gross product, as well as identify the most important factors affecting spending on national education in Algeria. This study found a direct relationship between the numbers of enrolled in education and real GDP growth, and an inverse relationship between the rate of education spending and the real GDP growth rate.

Mikdad Yousra and Abu Salem Fatima[5], the effects of educational spending on economic growth in light of the Millennium Development Plans: An evaluation benchmark study for the case of Algeria during the period (1990-2013): This study aimed to track the situation prevailing in Algeria by researching to know the relationship between income and educational spending and the impact of this on real income by clarifying the reciprocal relationship between educational spending and economic growth in addition to highlighting the importance of education in the formation of human capital through a standard study.
This study concluded that the contribution of human capital to economic growth during the study period was less than 50%, but this in 10 years, and this confirms the importance of the role played by human capital, and its contribution was distributed during 1999 by 109%.

Khalafalla Ahmed Mohamed Arabi & Suliman Zakaria Suliman Abdalla[6], The Impact of Human Capital on Economic Growth: Empirical Evidence from Sudan: This paper aimed at investigating the impact of human capital on economic growth in Sudan during the period (1982-2009) using a simultaneous equation model that links human capital presented by: school attainment and investment in education and health to economic growth. The empirical results of the

study show that quality of the education has a determinant role in the economic growth; health quality factor has a positive impact on economic growth as expected and total factor productivity which mainly represents the state of technology has adverse effect on economic growth and human development due to the obsolete and old fashion technology.

Mourad Tahtane[7], Human Capital and Economic Growth in ARAB Countries - An Empirical Investigation by Using Dynamic Panel Data Models during the Period (19902014): This study aimed at investigating the impact of human capital on economic growth in Arab countries, Using dynamic panel data models over the period 1990-2014, The Results indicate a positive and a significant relationship between human capital measured by enrolled in secondary education and economic growth in (PMGE) group. We find also, a similar and high significance at 99% of all of the variables included in this study (labor, physical capital stock, inflation, population growth rate), and the economic growth corrects the imbalance equivalent (28%) of each period.

Rachid Salmi & Mohamed Retea[8], Econometric Study of the Impact of Human Capital on Economic Growth in Algeria During the Period (1970-2014), journal of researcher: This study aims to determine the impact of human capital (expressed by secondary schooling crude percentage) on economic growth in Algeria (expressed by the rate of per individual share of GDP), during the period (1970-2014), and analysis of the equilibrium relationship between the two factors in the long run, the benchmark analysis revealed a statistically significant correlation between variations in human capital and economic growth as well as causal correlation between the two factors, which means that the increase in human capital lead to economic growth and vice versa, the results also revealed that economic growth is related to its determinants with joint complementary relationship, which includes the existence of equilibrium relationship in the long run.

The previous studies have helped us to define the basic concepts of human capital and economic growth and determine their indicators in addition to showing the role of education in the formation of human capital, but through our study we will enter the health indicator in addition to education as a key factor in maintaining human wealth, maintaining its productivity and efficiency, and we will expand the time period and add Other indicators related to education.

I.2.Theorical background:

In this point we will explain the concept of human capital and, the theatrical relationship between the human capital and the economic growth and the place of human capital in the growth models.

1.2.1. The concept of human capital:

The OCDE define human capital as: "The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being"[9]

According to Oxford English Dictionary "human capital is the skills, the labor force possesses and is regarded as a resource or asset."[10].

From those definitions and from the economic point of view we can define the human capital as an intangible good that can support and enhance the productivity, the innovation and the employment in addition to improve the standard of living by creating the economic and the social well-being.

Various theoretical models include human capital as a factor of production and assess the accumulation of human capital as an element of the growth process.

I.2.2. The relation human capital-economic growth:

We can determine the relation between the human capital and the economic growth through the examination of the different models and theories of economic growth that adopt the human capital as a factor that influence the variation of the GDP, on this base we present in this point the most important models that define the relation human capital/economic growth:

a. The model of Lucas (1988):

This model is based on the existence of externalities but in this case these externalities are introduced into the accumulation of human capital. Therefore according to Lucas, the global product is supposed to depend on physical capital (machinery, equipment, and infrastructure), human capital (skills) and the average level of human capital of the labor force. Physical capital and human capital are subject to diminishing returns, but their combined effect on the product is assumed to be all the greater as the average level of qualification in society is higher.

The production is written: $Y(t) = AK(t)^{\beta}[u(t)H(t)L(t)]^{1-\beta}H(t)^{\gamma}$ Where Y is the product, K the physical capital, L the labor, H the human capital, H the average human capital and u the time spent in the production[11].

b. Model Cass – Koopmans with human capital :

In this model inspired from Cass-Koopmans [1965], it takes into consideration the effects of human capital on the functioning of the economy. This model supposes that the accumulation of human capital is the result of a fraction of the revenue that the households devote for training. When it is postulated that human capital is accumulated by households that devote a constant fraction of their income to its acquisition, The empirical analyzes measure human capital using the level of educational expenditure [private or public or total] .When it is postulated that human capital is accumulated by households that devote a constant fraction of their income to its acquisition, empirical analyzes measure human capital using the level of educational expenditure [private or public or total] . And when the time spent on training is chosen, human capital is generally measured by the duration of schooling.

The production function of the economy has two arguments and is written:
$Y(t) = F(K(t), H(t))$ where (H) Represents the efficient work units (human capital) and will be accumulated as physical capital[12].

c. The model of Mankiw, Romerand Weil.(1992) (Solow's model with human capital) :

Basing on the production function that follows the traditional hypotheses of Solow model and thereby verifies the conditions inherent to neo-classical technology: positive and decreasing marginal productivities (relative to each of the factors of production), constant returns of scale (compared with all factors). From a formal point of view, the MRW model differs from the Solow model by the introduction of an additional variable representative of "human capital" in the production function. We thus have:

$Y(t) = F(K(t), H(t), A(t)L(t)) = k(t)^{\alpha} H(t)^{\beta} [A(t)L(t)]^{1-\alpha-\beta}$

With $\alpha > 0$, $\beta > 0$, $\alpha + \beta < 1$; α and β constant. Y is the flow of production, K is the physical capital stock, H is the stock of human capital, Has the level of technical progress, and L is the supply of labor[13]

d. Growth model with health:

Some works broadened the concept of human capital to the health in order to explain in a better way the growth and the international disparities in living standards because to function well, every economy should have a healthy labor force.

In view of the improvements in the productivity of the workers they entail, investments in the health sector are important factors for the economic growth and human development of a country.

Two approaches are used to measure the effects of health on growth. The first is based on the microeconomic effects of health [effects on workers' productivity], the second approach directly links health indicators (life expectancy at birth, mortality [of adults, children or global], morbidity rate...) with macroeconomic magnitudes.

The production technology of the economy is given by a noted Cobb-Douglas technology:
$Y(t) = K(t)^{a}L(t)^{1-a}S(t)^{b}$

Where K (t) is the stock of physical capital, L (t) labor, and S(t) health capital per capita[14].

II– Methods and Materials:

II .1.The construction of the model:
Our model is constructed basing on the function of production and the macro-econometric model used by Barro(1991) and Barro, Lee (2010).

The function that we employed to measure the impact of human capital on the economic growth is the following:
$$LGDP = f(LK, LL, LMYS, LLEB).$$

II .2. .Data Description and choice of variables:
The data used for investigating the impact of human capital on Algerian economic growth during the period 1990 to 2018 are the following:

LGDP: logarithm of the gross domestic product as a proxy variable for the economic growth.
LK: logarithm of the Physical Capital stock.
LL: logarithm of the labor factor.
LMYS*: logarithm of the Mean year schooling.
LEB: logarithm of the Life expectancy at birth.

The Data come mainly from the World Bank data base, WHO and UNDP data bases. In order to measure the dependent variable which is the economic growth, we used as a proxy the natural logarithm of GDP. We have used the mean years of schooling as a proxy for education human capital in this research paper which is the most widely used proxy of human capital. As for health human capital, our study employs life expectancy as proxy variable.
(Data symbols, details, description and sources are presented in the appendices, table1)

In addition to the mean years of schooling most of studies employ education enrolment ratio, government expenditure on education, literacy rates as proxies for education human capital.

As possible limitation noted by van Leeuwen and Foldvari (2008) is that none of these measures of education capture the differences in the quality of schooling but rather quantity measures. Instead of using these measures, it would have been preferable to use measures of student-to-teacher ratio or cognitive skills of the population such as students' achievements and mean test scores[15].
However, the lack of data on cognitive skills, student-to-teacher ratio, the expenditure on education and the enrollment rate in Algeria precludes their inclusion in our study.
Mean years or the Average years of schooling is a good measure of the human capital stock because it determines the educational investment accumulated in the current workforce.[1]

II .3. Physical capital calculation "K":
The physical capital stock in this period is interpolated backward by the following equation[16]:
$$K_{t-1} = (K_t - I_t)/(1 - \delta)$$

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* Regarding this factor, we tried to quantify this factor, we used the database for Barro Lee in 2000 established this base for 138 countries on which many economic researchers in the field of economic growth in particular rely,

[1] Les Oxley, Trinh Le, John Gibson, Measuring Human Capital: Alternative Methods And International Evidence, The Korean Economic Review Volume 24, Number 2, Winter 2008, P305-308

The WDI reports data of consumption of fixed capital in the period 1990-2018 as a percentage of GNI. These data can be taken as value of depreciation of capital stock. Using GDP deflator and data of GNI at current price we determine the data of real depreciation at the data of gross capital formation at constant price are also available in WDI.

Let I_t, D_t, δ_t and K_t* respectively denote gross capital formation, value of depreciation, depreciation rate and estimated capital stock
We have:

$K_1 = D_1/\delta_1$
$K_2 = I_2 + (1-\delta_1)K_1$
$\delta_2 = D_2/K_2$
$K_3 = I_3 + (1-\delta_2)K_2$
And so on…….

III- Results and discussion :

The procedure for estimating and presenting the results goes through several stages:

III.1. Time Series Study
To check the stationarity of the series and determine the order of integration I(d) of each one, we performed the ADF methodology and we adopted the Criterion of AIC and SC for the Lag length selection. The unit root test -ADF- results are shown in the appendices (Table 2). The results for this test show that:

a. **The LGDP series:** we obtained P=1 as a delay degree for the 'Lgdp series' which has the lowest value for the two criteria AKAIKE and SHWARTZ. For the unit root test, the calculated value (t-cal) is greater than the tabulated value at the level α = 5%; this indicates the presence of the unit root which means that the series is unstable and in order to make it stable we applied the1st difference which we obtained the DLGDP series, as a result, the calculated value of the Dicky Fuller statistic it is smaller than the tabulated value, this indicates that the series is stable and integrated at the 1st order.

b. **The LK series:** we obtained P=2 as a delay degree for the 'LK series' which has the lowest value for the two criteria AKAIKE and SHWARTZ. For the unit root test, the calculated value (t-cal) is smaller than the tabulated value at the level α = 5%; this indicates the absence of the unit root which means that the series is stable at level.

c. **The LL series:** The delay degree of this series is P=1, the unit root test shows that, the calculated value (t-cal) is greater than the tabulated value at the level α = 5%; this indicates the presence of the unit root which means that the series is unstable and in order to make it stable we applied the1st difference which we obtained the DLGDP series, as a result, the calculated value of the Dicky Fuller statistic it is smaller than the tabulated value, this indicates that the series is stable and integrated at the 1st order.

d. **The LMYS series:** For this series, delay degree was p=1, for the unit root test, the calculated value (t-cal) is smaller than the tabulated value at the level α = 5%; this indicates the absence of the unit root which means that the series is stable at level.

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* K_t is calculated by using the permanent inventory method basing on the initial capital K_0 calculated on 1969 Based on the work of professor Ahmed Zekan in his study of economic growth in Algeria and from the studies of Nehru et Dhareshwar.

e. **The LLEB series:** For the last series of our study, the delay degree was p=1. For the unit root test, the calculated value (t-cal) is smaller than the tabulated value at the level α = 5%; this indicates the absence of the unit root, so the EVN series is stable at level.
We summarized the results of the unit root test in the appendix (1)

According the previous results we conclude that:
− The independent variable is integrated in the 1ˢᵗ difference;
− All the variables of the study are DS type;
− None of the series is integrated into an order higher than 1.

Therefore the conditions required to perform the cointegration test using the ARDL approach are satisfied.

III.2. Application of the ARDL Cointegration Approach:

III.2.1. Bound test:

It seems from the previous results that the ARDL approach is more appropriate for our study, but we need to perform the Bounds test first, in order to emphasize whether a long-run relationship exists among the underlying variable or not, by computing the F-statistic using OLS method for testing the significance of the lagged levels of the variables in the error correction form. The performance of the bounds test proposed by Pesaran and al. (2001)[17] is indicated in Table 3 in the appendices.

The value of F-statistical test (Wald test value = **9.233192**) is higher than the upper bounds whether it is assumed that all the variables are I(0) or all the variable are I(1) and even upper from all the bounds proposed by Narayan (2005). Consequently, we reject the null hypothesis (H0) that assumes the absence of a long-run relationship (cointegration relationship). Therefore, a long-run relationship between the human capital variables and the economic growth variable exists.

III.2.2. The optimal ARDL model according to Akaike Information Criteria:

From the 1st plot we denote that the ARDL model (1, 1, 2, 1, 2) is the optimal choice among the 19 other presented models, it was picked because it has the less value of Akaike Information Criteria (AIC) (look to the appendices, Figure 1).

III.2.3. Diagnostic tests:

As we chose the optimal model for our study, we should ensure that our estimation will not suffer from non-normality of the error terms, serial correlation and heteroskedasticity.

a. **The normal distribution of residuals**:
According to Jarque-Bera statistic (probability= 0.79) so, we accept the null hypothesis (*H*0) which states that the residuals follow a normal distribution (Appendices, Figure 2).

b. **Testing the condition of the absence of a serial autocorrelation of the errors:**
In order to study the hypothesis of non-correlation of the errors, we refer to the test: (Breusch-Godfrey Serial Correlation LM Test) for the auto-correlation, where (*LM* = 1,18) with a probability higher than 5%, this indicates the acceptance of the null hypothesis *H*0 which means the no auto-correlation for the residuals (Appendices, table 4).

c. **Heteroscedasticity test :**
As we observe from table 5 (look to the appendices), prob= 0.3564 so the null Hypothesis (H0): No Heteroscedasticity of the error terms is accepted which means that our model doesn't suffer from the heteroscedasticity problem.

As a result, our model does not suffer from non-Normality of the residuals and Serial Correlation, these results allow us to say that our model is statistically accepted, in other word, our estimation is correct and the ARDL (1, 1, 2, 1, 2) highly explains the relationship between the human capital variables and the economic growth in Algeria.

III.2.4.ARDL Shor-run and Long-run Dynamics :

a. The Short-run Analysis – The Error Correction Model –:

The ARDL model is reparametrized into ECM when there is one cointegrating vector among the variables which is applicable in our case. The reparametrized result gives the short-run dynamics and the long run relationship between economic growth and the underlying human capital variables taken into consideration in this study.

The results presented in the (appendices, table6) show that the coefficient of the error correction CointEq (-1) is negative (-0.934020) and significant (Prob=0.0000), thus confirming the existence of a long run relationship between the variables of the model; this coefficient that expresses how quickly the equilibrium is restored once the model is out of equilibrium is estimated to be (-0.93) for our ARDL model, which indicates a high speed of readjustment to long run equilibrium.

Short-term results show that the stock of physical capital and the life expectancy at birth have a positive impact on the GDP, as for the variable (LL) has a positive impact on the economic growth while its past value (t-1) has a negative impact on the economic growth, on the other hand, the variable (LMYS) has no impact on the economic growth while its past value (t-1) has positive impact on economic growth.

About the negative impact of the LL in the time t-1we link that to the raison that the new labor always takes a time of a year to integrate the work and finish the trial period an addition to understand the professional world. In the other side the non impact of the mean years of schooling in the period t-1 refer to the lack of experience, in other word it considered as the period of learnin the exploitation of the knowledge and the accumulation of new skills related the the job

b. The Long-run Analysis – The Long-run Relationship –

As we have a single long-run relationship the ARDL, modeling procedure can distinguish between the regressors and the dependent variable, (the long-run relationship is illustrated in appendices table 7).

The long-run cointegration relationship equation estimated using our ARDL (1, 2, 2, 0, 0, 2) model is presenting as the following;

$$GDP = -6, 0622 + (0,2846*MYS + 3,36*LEB + 0,61511*K + 0,4334*L)$$

Long-run results show that all variables are statistically significant, where the stock of physical capital, the mean years of schooling, the life expectancy at birth and labor have a positive impact on the economic growth, which means that a 1% increase in the previous variables will increase GDP by 0,61%, 0,28%, 3,36% and 0,43% respectively. While the inflation has a negative impact on GDP, this means that increasing the degree of the inflation by 1% will decrease GDP by 0.007%.

III.2.5. The Stability test and the power of Prediction:

a. Stability test:

In order to verify the stability of the parameters of our ARDL model estimated over the long run, we rely on the "CUSUM" and "CUSUM squared" tests to test the consistency of the

long-run parameters. The CUSUM techniques based on the cumulative sum of recursive residuals and CUSUMQ based on the cumulative sum of the square of the recursive residuals are applied.

The results presented in the figure 3 (look to the appendices) show that the graph of CUSUM and CUSUMQ statistics remains within the range of critical values at the 5% threshold, which implies that the coefficients of the model are stable.

b. **The Power of Prediction:**
We note from the (appendices, figure 4) that the THEIL coefficient is very small and close to zero (0.00044) which indicates that the model has a high predictive ability**.**

IV- Conclusion:

The objective of this research is to highlight the role of human capital at driving economic in Algeria during the period 1990 to 2018 and to figure out whether this objective is realized and would be achieved in the future. To do that, we measured the influence of the education variable which is the mean years of schooling and health variable which is the Life expectancy at birth on the gross domestic product were used in our study to measure the economic growth using the ARDL approach. Finally, we have come up with a set of results that can be summarized as the following:

The stock of physical capital and life expectancy at birth have a positive impact on economic growth in the short and long term, while the mean years of schooling has no impact in the short run and a positive impact in the long run on the economic growth in Algeria during the study period, about the labor factor, its influence the economic growth in negative way on the short run and positive in the long run and the difference refer to the integration period of the new labor force on the economic sector and the acquisition of the necessary skills that increase the production in addition to exploit the accumulated knowledge of the education process in the short run   .

According to study results, the positive impact of human capital was achieved during the period of the study and would be accomplished in the future under these considerations.

So the human capital represented by the mean years of schooling as a proxy for the education and the life expectancy at birth as a proxy for the human health could be an important source of growth for the Algerian economy and an opportunity to diversify the sources of earns by using this durable source. To ensure better integration of Algeria into the world economy and take advantage of a potential vector of growth, a policy of reform for both of health and education sectors must be a part of the long run plan of the country in order to stimulate the economic growth.

During our study we met some obstacles and difficulties which are the non avalibility of the ful data about some education variales such as the enrolmenrt ratio for the secondary school in the last years also the information about the government expenditure on education by stages, literacy rates and the variable that measure the education quality such as the student-to-teacher ratio and cognitive skills of the population in Algeria. As suggestions for future researcher we propose to focus on the method of measurement of human capital and the choice of variables that can represent it in addition to give more importance to the education and health care quality rather than the quantitative variables.

- Appendices:

Table (1): Data description

Variable	symbol	description	Source
Gross domestic product per capita	GDP	The sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	world bank data
Physical Capital stock	K	Calculated by the author using the data of the world bank and the initial capital stock of 1969 basing on the following equation: $K_{t-1} = (K_t - I_t)/(1-\delta)$	Estimated by the author
Mean year schooling	MYS	average years of schooling of the population aged 25+	UNDP data base
Life expectancy at birth	LEB	The number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	WHO data base
Labor	L	Total employment-to-population ratio, 15 years and over (%)	world bank data

Source: developed by the authors using the information of the World Bank, WHO and UNDP.

Table (2): Results of ADF test

variables	order		intercept	Prob	Trend and intercept	Prob	none	Prob
			t-cal		t-cal		t-cal	
LGDP	I(0)	t	-0.025	0.94	-2.48	0.33	3.29	0.99
	I(1)	t	-3.78	0.008	-3.60	0.04	-0.88	0.1
LL	I(0)	t	-1.16	0.673	2.696867	0.245	-0.131	0.639
	I(1)	t	-4.27	0.0025	-4.19	0.0139	-4.35	-0.0001
LMYS	I(0)	t	-3.56	0.013	-2.09	0.52	2.45	0.99
	I(1)	t	---	---	---	---	---	---
LLEB	I(0)	t	-1.214608	0.6530	3.674519	1.0000	-2.108382	0.0358
	I(1)	t	---	---	---	---	---	---
LK	I(0)	t	-2 .246	0,195	-4.4412	0.0079	1.535	0.965
	I(1)	t	---	---	---	---	---	---

Source: developed by the author using eviews10

Table (3): Bounds test

| Test Statistic	Value	Signif.	I(0)	I(0)2*	I(1)	I(1)*
F-Statistic	9.233192	10%	2,45	2.496	3,52	3.346
	K = 4	5%	2,86	2.962	4,01	3.910
		1%	3,74	4.068	4,68	5.06

Source: developed by the author using eviews10

2* I(0)* and I(1)*, According to Narayan (2005), the existing critical values in Pesaran et al. (2001) cannot be applied for small sample sizes as they are based on large sample sizes that's why Narayan (2005) provides a set of critical values for small sample sizes, from 30 to 80 observations, which is our case (22 observations). The critical values are 2.496 - 3.346, 2.962 -3.910, and 4.068 – 5.250 at 90%, 95%, and 99%, respectively. (Nkoro & Uko, 2016)

Figure (1): Akaike Information Criteria
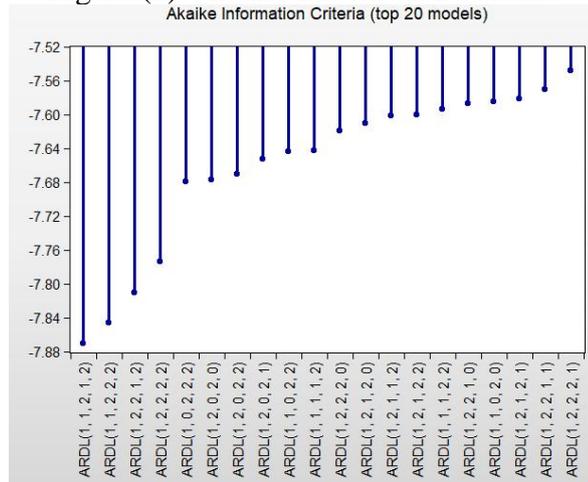
Source: Eviews 10 output.

Figure (2): Normality test
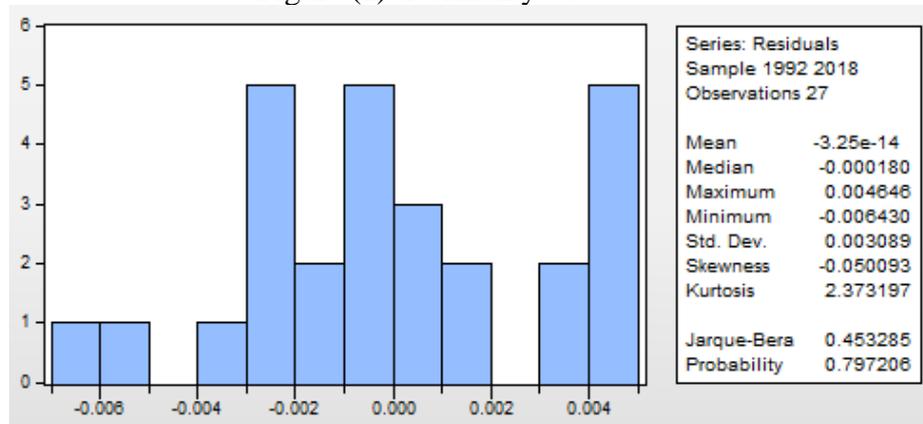
Source: Eviews 10 output.

Table (4): Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM test			
F-statistic	1,180888	Prob. F(1,14)	0.2955
Obs*R-squared	2,1002	Prob.Chi-Square	0,1473

Source: developed by the author using eviews10

Table (5): Heteroscedasticity test

| Test Hypothesis	Test	Value / F-statistic	prob
H0: No Heteroscedasticity of the error terms	Breusch-Pagan-Godfrey Arch-	1.213133	0.3564

Source: developed by the author using eviews10

Table (6): short run estimation

variable	Coefficient	Std. Error	t-Statistic	Prob
D(LLEB)	67.60614	7.176936	-9.419917	0.0000
D(LK)	1.837497	1,192444	9.548237	0.0010
D(LMYS)	0.062708	0.064337	0.974684	0.3452
D(LMYS(-1))	0.320956	0.081622	3.932242	0.0013
D(LL)	0.080068	0.054641	1.465356	0,1635
D(LL(-1))	-0,234227	0.063469	-3.690385	0.0022
CointEq(-1)	-0.934020	0.197805	-7.080616	0.0000

Source: developed by the author using eviews10

Table (7): Long run estimation

variable	Coefficient	Std. Error	t-Statistic	Prob
LK	0.615110	0.054333	11.321171	0.0000
LL	0.433494	0.111102	5.821457	0.0014
LLEB	0.206201	0.948850	3.545054	0.0029
LMYS	0.284691	0.127848	-2.226788	0.0417
C	-6.062207	1.521124	-3.985346	0.0012

Source: developed by the author using eviews10

Figure (3): The stability of the coefficients during the estimation period.
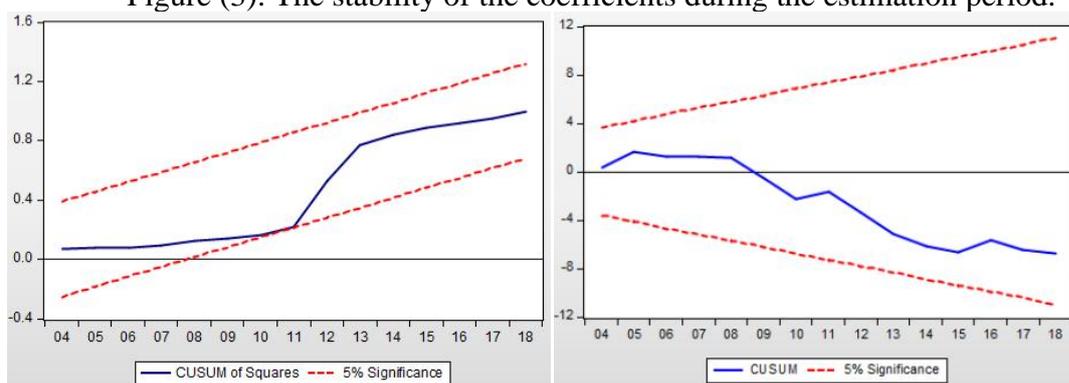
Source: Eviews 10 output.

Figure (4): Theil test
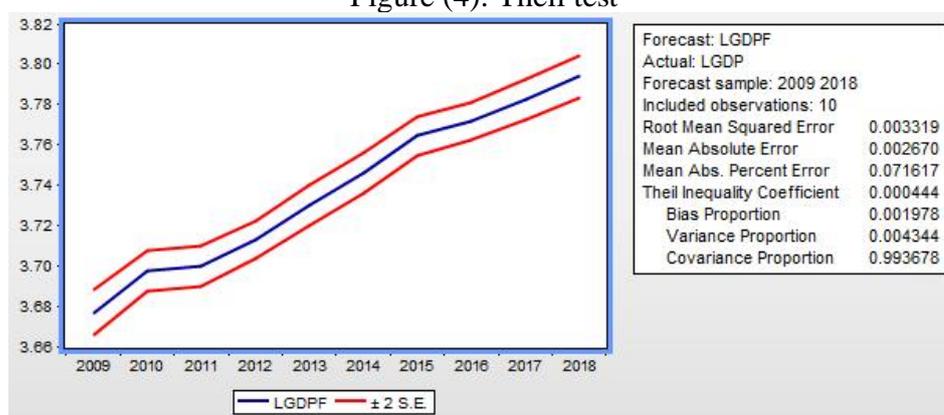
Source: Eviews 10 output.

Referrals and references:

1 OCDE. (1998). **l'Investissement dans le capital humain: une comparaison Internationale**. Paris: OCDE, P9

2 Kinvi D.A, L. (1995). **Capital humain et croissance économique : une revue de la littérature**. Économie de l'éducation . (116), PP17-34.

3 Krasniqi, F. X. (2016). **The Importance of Investment in Human Capital: Becker, Schultz and Heckman**. Journal of Knowledge Management, Economics and Information Technology. 6(4), PP1-18.

4 Mousaoui Mohamed(2014), **the Impact of Investing in Human Capital on Economic Growth: A Case Study of Algeria**, PHD Thesis, Abu Bakr Belkaid University - Tlemcen -,(Written in Arabic).

5 Mikdad Yousra and Abu Salem Fatima(2015), **the effects of educational expenditure on economic growth in light of the Millennium Development Plans: An evaluation benchmark study for the case of Algeria during the period (1990-2013)**, El Bachair Eliktisadia review 1(1), Algeria: university of Bechar, PP91-105, Visited: 11/01/2020, https://www.asjp.cerist.dz/en/article/11556 (Written in Arabic).

6 Khalafalla Ahmed Mohamed Arabi & Suliman Zakaria Suliman Abdalla (2013), **The Impact of Human Capital on Economic Growth: Empirical Evidence from Sudan**, Research in World Economy review 4(2), PP43-53.

7 Mourad Tahtane, Omran Bechrair (2017), **Human Capital and Economic Growth in ARAB Countries - An Empirical Investigation by Using Dynamic Panel Data Models During the Period (19902014)**, El-bahith review 17(17), Algeria: University of Kasdi Merbah Ouargla, P249-258, Visited: 20/01/2020, https://www.asjp.cerist.dz/en/article/34430 (Written in Arabic).

8 Rachid Salmi & Mohamed Retia (2017), **Econometric Study of the Impact of Human Capital on Economic Growth in Algeria During the Period (1970-2014)**, El-bahith review 17(17), Algeria: University of Kasdi Merbah Ouargla, PP259-270, Visited: 21/01/2020, https://www.asjp.cerist.dz/en/article/113822 (Written in Arabic).

9 OCDE. (2007). **human capital: thevalue of poeple**. Paris: OCDE, P29.

10 Glodin, C. (2016). **Handbook of Cliometrics: human capital**. Berlin: springer, P1.

11 Gaffard, J.-L. (2011). **la croissance économique**. paris, france: Armand Colin, P40.

12 Mokime, A. N. (2014). **la croissance économique : une prespective africaine**. L'harmattan, P178.

13 Cem, e., & Kalidou, T. (2005). **croissance, capital humain et interactions spatiale**. Bourgogne: Universit de Bourgogne, PP1-33.

14 Mokime, A. N. (2014). **la croissance économique : une prespective africaine**.L'harmattan, P191

15 Ogundari, K., & Awokuse, T. (2018). **Human capital contribution to economic growth in Sub-Saharan Africa: Does health status matter more than education?**, economic analysis and policy(58), PP131-140.

16 Nguyen, T.-A. (2009). **Sources of Economic Growth: Physical capital, Human Capital, Natural Resources,and TFP**. paris: UniversitéPanthéon-Sorbonne, P177-120.

17 Pesaran, M., Shin, Y., & Smith, R. (2001). **Bounds testing approaches to the analysis of level relationships**. journal of applied econometrics, PP289-326.