The Impact of Human Capital on Economic Growth in Algeria During the Period 1970-2018: Application of ARDL Approach to Cointegration

تأثير رأس المال البشري على النمو الاقتصادي في الجزائر خلال الفترة 1970–2018: بتطبيق منهجية ARDL للتكامل المشترك

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Abstract:

The study aims to test the impact of human capital on economic growth in Algeria during the period 1970-2018, by using the autoregressive distributed lag (ARDL) model through application the bounds test to cointegration to estimate the relationship in short and long term. We also used the PIM method to estimate thecapital (K) in the model based on the gross fixed capital formation.

Through the findings, the study concluded to the existence of negative impact of human capital on economic growth in Algeria in the long term, but it has no effect in the short term.

Keywords: Human Capital; Economic Growth; ARDL Model; Bounds Test.

JELClassificationCodes:E24, J24, O47, C22.

ملخص:

تهدف الدراسة إلى اختبار أثر رأس المال البشري على النمو الاقتصادي في الجزائر خلال الفترة 1970–2018 وذلك باستخدام نموذج الانحدار الذاتي للفجوات الزمنية الموزعة ARDL، مع استخدام اختبار الحدود Bounds Test للتكامل المشترك لتقدير العلاقة في الأجلين القصير والطويل، كما تم استخدام طريقة PIM في تقدير رأس المال المادي بناءً على إجمالي تكوين رأس المال الثابت؛

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ومن خلال النتائج المتوصل إليها خلصت الدراسة إلى وجود تأثير سلبي لرأس المال البشري على النمو الاقتصادي في الجزائر على المدى الطويل، وعدم وجود تأثير على المدى القصير.

كلمات مفتاحية: رأس المال البشري، النمو الاقتصادي، نموذج ARDL، اختبار الحدود

تصنيفات JEL: C22, O47, J24, E24

1. INTRODUCTION

The research process in economic growth theory has gone through three basic stages:**the first stage** was marked by a focus on the importance of physical capital; whereas**the second stage** was characterized by focusing on the importance of substitution between work and material capital; as for **the third stage**, it focused on the importance of human capital in increasing economic growth, and the investment in human capital is by following many methods, one of these methods is investing in education.

On the other hand, we note in principle that Algeria is making a lot of efforts to invest in human capital through spending on: the primary, middle and secondary education sector; the higher education sector; the vocational education and training sector; health sector.

However, the question remains as to whether the investment in human capital in Algeria really plays its major role in increasing economic growth, as demonstrated in endogenous growth models.

This also leads us to question the nature of the relationship that exists between human capital and economic growth in Algeria. Is it compatible with the findings of the internal growth models, or is it the opposite? Is there positive impact of the human capital on economic growth or not?

2. Literature Review

2.1 The evolution of economic growth theory

The research on the causes of economic growth has occupied the interest of economic researchers over time.The focus in the causes of economic growth in its first stage was limited to the role of the division of labor in the production process(Adam-Smith, 1776), In addition to that, it was pointed out the role of capital accumulation and the effect of the both savings and investment on production(Harrod, 1939)and (Domar, 1947)assuming then theories of equilibrium long-term growth.Then came the second stage of research in the theory of economic growth, where the neoclassical model of(Solow, 1956) and (Swan, 1956)appeared (these

models called "exogenous growth models"), and at the same time period for the emergence of the neoclassical model of growth, the earliest signs of the beginning of an appearance the human capital theory at the end of the fifties, through Contributions by Jacob Mincer(Mincer, 1958), Theodor Schultz (Theodore, 1961)and Gary Becker(Becker, 1962), as interest in the human factor increased during this period, and work began to transcend superficial ideas about the human factor. Where the transition was moved from the idea of his being contributing only to production through the hours of work that he provides, to his role In increasing technological development or progress by employing the knowledge, ideas, experiences, and skills that owned by the human factor - especially the workforce or labor force - in the productive process.And accordingly, the concept of investing in the human factor emerged, which was called “investing in human capital” through investing in (education, training, learning by doing, health).

In the third stage of research in the theory of economic growth, endogenous growth models emerged through the contributions of(Romer, 1986), (Laucas, 1988), (Gregory, Romer, & Weil, 1992),(Benhabib & Spiegel, 1994), These models have worked to overcome the shortcomings experienced by previous models by expanding the concept of capital to include physical and human capital, in addition to including the following factors in the economic growth models: knowledge, education, training, learning by doing, research and development (R&D), innovations.

2.2Impact of human capital on economic growth: evidence from previous studies

To provide good evidences to impact of human capital on the economic growth we mention some previous studies that have tested this relationship as follows:

As for study of (Afzal, Shahid, Hafiz, Begum, & Quddus, 2010) it attempted to test the relationship between education and economic growth in Pakistan during the period 1970-2009 using the ARDL model. The study found a direct relation (positive relation) in both directions between education and economic growth in Pakistan in the long term, an inverse relationship (negative relation) in two-way between education and economic growth in the short term. For the same country, the study (Afridi, 2016) examined the relationship between human capital and economic growth in Pakistan during the period 1972-2013 using the ARDL model, and he also found a positive impact in the long term.

As for the study(Taofik, 2016), it tested the effect of investment in

human capital on economic growth in Nigeria during the period 1980-2014 using the ECM error correction model (ECM) and the fully modified ordinary least square (FMOLS). The study found a positive effect of investment in human capital on economic growth.

And we find the study of (Benyahia & Elliyana, 2019) tried to presented the role of human capital as a factor increasing the level of growth and its importance in the economy, then clarify the relationship between human capital and economic growth in Indonesia. The study concludes to: I-Primary and secondary education is the foundation of the Indonesian knowledge sector; II-The return from investment in human capital in Indonesia is low level because its economy concentrates more on traditional forms of capital; III- Disparities between provinces are quite large in Indonesia due to an unbalanced development strategy.

For Algeria, the study (Moussaoui, 2015) tested the impact of investment in human capital on economic growth in Algeria during the period 1970-2011, and the study used both OLS and FMOLS in the estimate. The study found that there is a weak positive impact for the number of enrolled in educational levels on economic growth, and the value of the greatest impact was in the share of intermediate education, while the value of impact of enrolled in university education on economic growth was low compared with the rest of the levels, and the study also found a negative effect of spending to education on economic growth.

The study of (Sabki & Belmokadem, 2019) tried to examine the causal relationship between education and economic growth in Algeria during the period 1980-2016, based on a recent method of testing the granger causality provided by Toda-Yamamoto and based on the VAR model. The study results conclude to the absence of the causal relationship between economic growth, expenditure on education, and enrollment in higher education.

The current study aims to test the impact of human capital on economic growth in Algeria during the period 1970-2018, using the autoregressive distributed lag (ARDL) model through application the bounds test to cointegration to estimate the relationship in short and long term, and the PIM method to estimate the capital (K) in the model based on the gross fixed capital formation.

3. Methodology

This study investigates the dynamic relationship between human capital and economic growth in Algeria.

3.1 Functional form of the model

Enter Following to (Solow, A Contribution to the theory of economic growth, 1956) ;(Gregory, Romer, & Weil, 1992) ;(Benhabib & Spiegel, 1994) ; had considered that economic growth depends on the basic factors: labor and physical capital,after that human capital have included. And the economic growth model in form Cobb-Douglas equation can presented as following:

$$GDP_t = {K_t}^{\alpha} {L_t}^{\beta} {H_t}^{\gamma} \text{....(1)}$$

After used the logarithm in the previous model, this paper adopts in formulating the formal framework of the relation between human capital and economic growth, the following model:

$$LnGDP_t = \alpha LnK_t + \beta LnL_t + \gamma LnH_t + \varepsilon_t \text{....(2)}$$

Where: GDP short for gross domestic product ; K is physical capital ; H is human capital ; ε_t is error term. Lnisnaturallogarithm.

3.2 ARDL Methodology

The previous model can be presented according to the following ARDL form:

$$LnGDP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i LnGDP_{t-i} + \sum_{j=0}^{q1} \beta_{1j} LnK_{t-j} + \sum_{j=0}^{q2} \beta_{2j} LnL_{t-j} + \sum_{j=0}^{q3} \beta_{3j} LnH_{t-j} + \varepsilon_t \text{....(3)}$$

The Error Correction Model can be written as follows:

$$\Delta LnGDP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta LnGDP_{t-i} + \sum_{i=0}^{q1} \alpha_{2i} \Delta Lnk_{t-i} + \sum_{i=0}^{q2} \alpha_{3i} \Delta LnL_{t-i} + \sum_{i=0}^{q3} \alpha_{4i} \Delta LnH_{t-i} + \rho LnGDP_{t-1} + b_1 LnK_{t-1} + b_2 LnL_{t-1} + b_3 LnH_{t-1} \text{....(4)}$$

Or can be written as follows:

$$\Delta LnGDP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta LnGDP_{t-i} + \sum_{i=0}^{q1} \alpha_{2i} \Delta Lnk_{t-i} + \sum_{i=0}^{q2} \alpha_{3i} \Delta LnL_{t-i} + \sum_{i=0}^{q3} \alpha_{4i} \Delta LnH_{t-i} + \rho \xi_{t-1} \text{....(5)}$$

Where: $\boldsymbol{\xi_{t-1}}$is the error correction term

$$\xi_{t-1} = LnGDP_{t-1} - c_1 Lnk_{t-1} - c_2 LnL_{t-1} - c_3 LnH_{t-1} \text{....(6)}$$

$\boldsymbol{\alpha_0}$: represents the constant term in the model (or represents the total productivity of factors TPF);

$\boldsymbol{\alpha_1}$‘$\boldsymbol{\alpha_2}$‘$\boldsymbol{\alpha_3}$‘$\boldsymbol{\alpha_4}$**:** represent the short-term effect ;

$\boldsymbol{b_1}$‘$\boldsymbol{b_2}$‘$\boldsymbol{b_3}$**:** represent the long-term effect ;

$\boldsymbol{\rho}$: is the error correction coefficient, and must be significant and negative($\boldsymbol{\rho} < 0$).

The ARDL model has many advantages (CHERIFI, BELHADRI , & MEDDAH, 2019); (Benmeriem, 2018);(Nkoro & Uko, 2016) ; (EL-Shourbagui, 2009) we mention some of them as follows:

- The bounds test for cointegration does not assume a restrictive assumption that all variables are cointegrate at the same degree, as it can be applied regardless of whether the variables under study are integrate of different degrees (I(0) or I(1)), or integrated of the same degree;
- The results of its application are good even if the sample size (number of observations) is small (such as the case of our study where the sample size or number of observations reached 48 years from 1970 to 2018), and this is the opposite of most traditional cointegration tests that require a large sample size in order to be the results are more efficient;
- ARDL approach helps reduce autocorrelation problems;
- The ARDL approach generally provides unbiased estimates of the model over the long term;
- The use of the ARDL approach allows estimating the relationship in the short and long term together simultaneously and in one equation;

The use of the ARDL approach allows the inclusion of dummy variables in the cointegration test.

3.3Data and Sources

Our empirical study is based on an annual data series for the Algerian economy during the period (1970-2018) and application the ARDL model to estimate cointegration through bounds test, and we will test the relation in the short and long run between human capital and economic growth.

The GDP Data were obtained from World Development Indicators database (WDI, 2020). As for Labor data were obtained from the National Office of Statistics of Algeria.

For human capital data, both the number of those enrolled in secondary education and the number of those enrolled in higher education were used. Human capital data were obtained from the ministry of national education and the ministry of higher education.

4. Results and discussion

In this section related to the results and discussion, and given to the specificity of the econometric study. We have to verify the nature of the relationship between human capital and economic growth in Algeria during the period 1970-2018, and we have to test the study hypothesis, in order to achieve this,we will applied following steps:

- Stationarity test of series;
- Boundstest;
- Estimate of ECM-ARDL;
- Estimate ARDL long-run form;

Estimate ARDL short-run form.

4.1Stationarity test of series

Models with time series display nonstationarity properties and which if did not corrected would result in spurious regressions. Therefore, unit roots testing and cointegration becomes a starting step to analyzing in the short and long-run term. Also application of ARDL model required that all series must be not I(2) (not integrate of second degree).

To test the stationarity of all series, this study used the both Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests,where table 01 presents unit root test statistics and the estimated p-values for variables' time series used in the model. It is observed that the null hypothesis of unit root could not be rejected for levels series because the p-values for these series are large, where we cannot reject unit root even at the lower significance level of 10%.

However, when the unit root test is applied to differenced series, the null hypothesis is rejected for all series, where, the calculated statistics values for the PP and ADF test for series at first difference has been greater (in absolute value) than the tabular statistics at 1% level of significance.

Therefore, we conclude that all series are stationary at first difference, which mean all series are I(1).

4.2Bounds test

The bounds test is based on autoregressive distributed lag (ARDL) model, this method is called the bounds testing approach to cointegration, which was developed through many studies, specially through contribution of (Pesaran, Shin, & Smith, 2001).

The ARDL bounds testing depends on three factors: (i) number of regressors (k) ; (ii) number of observations (n) ; and (iii) whether variables are I(0) and (I(1) or not.

In this study, number of observation is 48 years which mean n=48; there are three independent variables that mean k=3; for assumption III, all variables are I(1).

The ARDL bounds testing procedure is performed after the estimation of equation (4) or equation (5).The optimum lags are determined for the model until we finally reach the best ARDL model which is to be used in the bounds test in step later, usually the optimum lags determined by using one of information criteria as (AIC, SIC, HQ). Based on the akaike information criteria (AIC), an ARDL (1, 2, 0, 0) has been selected.

The bounds test is applied by testing the null hypothesis $\mathbf{H_0}$, which states that there is no cointegration between the variables versus the

alternative hypothesis $\mathbf{H_1}$which assumes the existence of a cointegration between the variables as follows:

$$\begin{cases} H_0 : \rho = b_1 = b_2 = b_3 = 0 \\ H_1 : \rho \neq b_1 \neq b_2 \neq b_3 \neq 0 \end{cases}$$

In order to test the presence of a cointegration between the study variables, specially, the testing of a cointegration between economic growth and human capital, the calculated Fischer statistic is compared with the bounds of the critical values extracted from the critical value tables of (Pesaran, Shin, & Smith, 2001)and(NARAYAN , 2005). The test results are summarized in the following table:

Table 1:ARDL bounds test results

H0	**There is no cointegration between the variables**		
F-Bounds Test	**Pesaran et al 2001**		**Dicision**
critical values	**Lower Bound**	**Upper Bound**	
significantat 10%	**2.01**	**3.1**	The null hypothesis is rejected and accept the alternative hypothesis.
significantat 5%	**2.45**	**3.63**	
significantat1%	**3.42**	**4.84**	
F-Bounds Test	**Narayan 2005**		**Dicision**
critical values	**Lower Bound**	**Upper Bound**	
significantat 10%	**2.538**	**3.398**	The null hypothesis is rejected and accept the alternative hypothesis.
significantat 5%	**3.048**	**4.002**	
significantat 1%	**4.188**	**5.328**	
	number of independent variables	**(F) Statistic**	**Conclusion**
Test Statistics	K = 3	F= **5.821522**	There is cointegration

Source: by authors,adapted from Eviews 10.0

Table 1 provides the results of the bounds test, where the bounds testing approach to cointegration was applied through estimation of the equation 4, and the null hypothesis $\mathbf{H_0}$ for the cointegration test is "there is no cointegration" have tested.

Bounds test shown that the null hypothesis is rejected because the calculated value of F = 5.82 is greater than the upper bound of critical values at all levels of significance for both the critical values of (Pesaran, Shin, & Smith, 2001)and(NARAYAN , 2005).

Therefore, we accepting the alternative hypothesis, and this means that there is a relationship of cointegration between the variables of the study, andespecially there is a cointegration relationship in the long-run between economic growth and human capital.

4.3Estimate of ECM-ARDL

After we have confirmed the existence of cointegration between the study variables depending on the bounds test, we move to estimate the error correction model of ARDL (ECM-ARDL), and estimate the equation of error correction term, to check assumption related to error correction coefficient (must be significant and negative ($\boldsymbol{\rho} < 0$)). Results estimation of ECM-ARDL are summarized in the following table:

Table 2: Equation of Error Correction Model to ARDL (ECM-ARDL)

General Form of ECM-ARDL:

$$\Delta LnGDP_t = \sum_{i=1}^{p} \alpha_{1i}\Delta LnGDP_{t-i} + \sum_{i=0}^{q1} \alpha_{2i}\Delta Lnk_{t-i} + \sum_{i=0}^{q2} \alpha_{3i}\Delta LnL_{t-i} + \sum_{i=0}^{q3} \alpha_{4i}\Delta LnH_{t-i} + \rho LnGDP_{t-1} + b_1 LnK_{t-1} + b_2 LnL_{t-1} + b_3 LnH_{t-1}$$

Results estimate of ECM-ARDL :

$$\Delta LnGDP_t = \alpha_{2i}\Delta Lnk_{t-1} + \alpha_{2i}\Delta Lnk_{t-2} + \rho LnGDP_{t-1} + b_1 LnK_{t-1} + b_2 LnL_{t-1} + b_3 LnH_{t-1}$$

$$\Delta LnGDP_t = 1.15\Delta Lnk_{t-1} - 0.89\Delta Lnk_{t-2} - 0.13 LnGDP_{t-1} + 0.096 LnK_{t-1} + 0.129 LnL_{t-1} - 0.07 b_3 LnH_{t-1}$$

***(2.71)	**(-2.32)	**(-2.10)	*(1.85)	***(2.71)	-2.86)

Notes:Δdenote to first difference ;ρ denote to error correction parameter ; Values in parentheses is T-statistics.
***, ** and * show statistical significance of coefficients at 1%, 5% and 10%, respectively.

Source: by authors, adapted from Eviews 10.0

From results of table 2 we conclude that the human capital coefficient is negative andsignificant at 1%; also the assumption aforementioned for the coefficient of the dependent variable at the one-year slowdown (dependent variable with one lag) $\boldsymbol{LnGDP_{t-1}}$is negative and significant at 5% (i.e. error correction coefficient is negative and significant and this confirms the relationship between variables in long-run); and the results of estimate the equation of error correction term can be summarized in the following table:

Table 3: The Error Correction Term Equation

The General Form of The Error Correction Term Equation :

$$\boldsymbol{\xi_{t-1} = LnGDP - (c_1 LnK + c_2 LnL + c_3 LnH)}$$

$$\boldsymbol{\alpha = c_1 = \frac{-b_1}{\rho}} ;\boldsymbol{\beta = c_2 = \frac{-b_2}{\rho}} ;\gamma = c_3 = \frac{-b_3}{\rho}$$

Results of estimate Error Correction Term Equation :

$$\boldsymbol{\xi_{t-1} = LnGDP - (0.7038 LnK + 0.9492 LnL - 0.5065 LnH)}$$

$$\boldsymbol{\alpha = c_1 = \frac{-(-0.07)}{-0.13} = 0.5065} ;\boldsymbol{\beta = c_2 = \frac{-0.129}{-0.13} = 0.9492} ;\gamma = c_3 = \frac{-0.096}{-0.13} = \mathbf{0.7038}$$

Source: by authors, adapted from Eviews 10.0

We point out that the error term equation comprises long-term

coefficients or elasticities of real GDP for both physical capital, labor and human capital, this estimation based on equations 2 And 6.

The results of estimation (in table 3 above) are indicate there are positive impact for both physical capital and labor on economic growth; but there is a negative impact for human capital on economic growth in Algeria during period 1970-2018.

4.4ARDLlong-run form

Results of estimate the ARDL long-run form (levels equation) or estimate the long-run impact coefficients, it can be summarized in the following table:

Table 4: Results of ARDL long-run form

General Form of the Long-Run:

$$LnGDP_t = \alpha LnK_t + \beta LnL_t + \gamma LnH_t$$

$$\alpha = c_1 = \frac{-b_1}{\rho}; \beta = c_2 = \frac{-b_2}{\rho}; \gamma = c_3 = \frac{-b_3}{\rho}$$

Results of estimate the Long-Run:

$$LnGDP_t = 0.703LnK_t + 0.949LnL_t - 0.506LnH_t$$

Levels Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNK	0.703803	0.071567	9.834117***	0.0000
LNL	0.949224	0.213021	4.456018***	0.0001
LNH	-0.506460	0.096325	-5.257812***	0.0000
Diagnostic tests		JB	LM	ARCH
Statistic		*0,5628*	0.771598	0.070394
Probability		*0,7547*	0.4692	0.7920

Note: * show statistical significance of coefficients at 1%.**

Source: by authors, adapted from Eviews 10.0

Table 4 provides the results of ARDL long-run form, and these results can be summarized as follows:

- All variables are significant at significance level of 1% by the corresponding P-Values of each variable;
- The coefficient of physical capital and the coefficient of labor in the long term are significant and positive, which means that the physical capital and labor affect positively on economic growth in the long term;

- The coefficient of human capital in the long term is significant and negative, which means that human capital negatively effects on economic growth in the long term.

4.5 ARDLshort-run form

Results of estimate the ARDL short-run form or estimate the short-run impact coefficients, it can be summarized in the following table:

Table 5: Results of ARDL short-run form

General Form of the Short-Run Equation:

$$\Delta LnGDP_t = \sum_{i=1}^{p} \alpha_{1i}\Delta LnGDP_{t-i} + \sum_{i=0}^{q1} \alpha_{2i}\Delta Lnk_{t-i} + \sum_{i=0}^{q2} \alpha_{3i}\Delta LnL_{t-i} + \sum_{i=0}^{q3} \alpha_{4i}\Delta LnH_{t-i} + \rho\xi_{t-1}$$

Results estimate of of the Short-Run Equation:

$$\Delta LnGDP_t = \alpha_{2i}\Delta Lnk_{t-1} + \alpha_{2i}\Delta Lnk_{t-2} + \rho\xi_{t-1}$$
$$\Delta LnGDP_t = 1.154\Delta Lnk_{t-1} - 0.89\Delta Lnk_{t-2} - 0.13\xi_{t-1}$$

ARDL Short Run Form
ARDL Error Correction Regression
Dependent Variable: D(LNGDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNK)	1.154923	0.329915	3.500669	0.0011
D(LNK(-1))	-0.890682	0.317930	-2.801507	0.0077
CointEq(-1)*	-0.136449	0.027295	-4.998995	0.0000
R-squared	0.501418	Meandependent var		0.033474
Adjusted R-squared	0.478756	S.D. dependent var		0.025037
S.E. of regression	0.018076	Akaike info criterion		-5.126782
Sumsquaredresid	0.014376	Schwarz criterion		-5.008687
Log likelihood	123.4794	Hannan-Quinn criter.		-5.082342
Durbin-Watson stat	1.640205			

Source: by authors, adapted from Eviews 10.0

According to table 5, the results of estimation the ARDL short-run form can be summarized as follows:

- Error correction coefficient is negative and significant at 1%, and this confirms the relationship between variables in the short-run;
- The rest of the transactions were significant at the level of 1%;
- The only variable that effects on economic growth in the short term is physical capital;

- Absence of impact of human capital on economic growth in the short term.

4.6Results of diagnosis tests:

Based on the previous results of the long and short-run equations for the previous ARDL model.We conclude group of points which can be summarized as follows:

- The error correction coefficient is negative and significant at the level of 1%. This result is considered as a support to confirm a long-term equilibrium relationship between the variables and specially it is helped to confirm the relationship between human capital and economic growth;
- The value of error correction coefficient (-0.1365) indicates that 13.65% of short-run disequilibrium of economic growth can be corrected within one unit of time in order to return to equilibrium again in the long term which is when economic growth deviates during the short period (t-1) from its equilibrium values in the long-run the equivalent of 13.65% of this deviation is corrected in the period (t), likewise it can be said that the economic growth will take about (1/0.1364 =7.33) 7 years and 4 months to return to its equilibrium;
- The estimation results also showed that most of the estimated parameters were statistically significant at varying significance levels with the exception of variables in the short-run;
- It is also clear (from table 05) that the value of R-squared reached to 0.5014% which means that variations in independents variables explain just 50.14% of the changes in the economic growth;
- The Durbin-Watson statistic (see table5) does not suggest an autocorrelation errors of the first degree (which means there is no autocorrelation errors of the first degree);

Finally, it appears clearly from the lower part of table 4 section that the diagnostics tests yielded good results to he estimated model, these results can be displayed as follows:

- In particular, the Jarque-Bera test is usually applied before other diagnostics tests to confirm normality as first step, where the null hypothesis for this test is that the data is normally distributed, in our study, the normality test results indicate acceptance of the null hypothesis, which confirms normality;
- The model does not suffer from autocorrelation of degree greater than 1, because the Breusch-Godfrey Lagrange multiplier test (the LM test) accepted the hypothesis of no serial correlation, in which the null

hypothesis of this test is that there is no serial correlation in the residuals up to the specified order. The LM test indicate that the residuals are not serially correlated;

- We test the heteroscedasticity of the variance through the autoregressive conditional heteroskedasticity (ARCH) test, where the results shown through that the probability is greater than 5% and thus the null hypothesis (there is no heteroscedasticity) is accepted, that is, the residuals in the model have homogeneous variance.

After previous tests, we test the structural stability of the short and long-term coefficients, that is, test the stability of the model over the entire study period using some stability techniques, namely:

- Cumulative sum (CUSUM) tests ;
- Cumulative sum of squares (CUSUM) tests;

For the model to be stable throughout the study period, must the CUSUM and CUSUM of squares curves within the critical limits are at the 5% of significance level, the critical limits at the 5% level of significance are painted in red, while the CUSUM and CUSUM of squares curves are blue, and this can be illustrated by the following figures:

Fig.1. CUSUM test

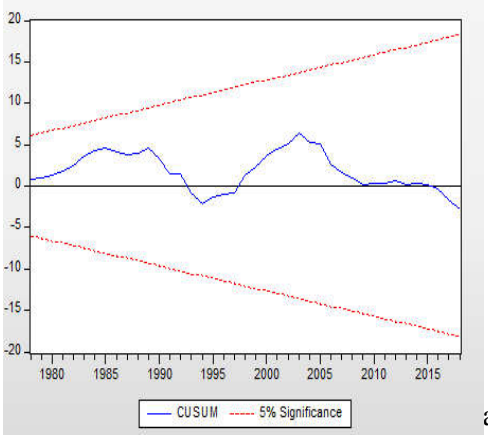
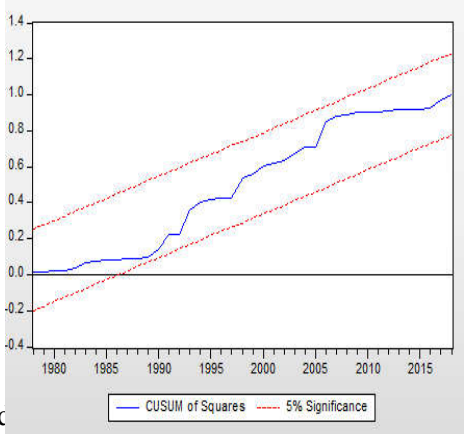


Fig.2. CUSUM Of squares test



ac

It is clear from the two figures above that the estimated model is structurally stable during the study period, where we notice that the cumulative sum curves of and the cumulative sum of squares (CUSUM and CUSUM of squares) are located within the critical limits at the significance level of 5%.

5. CONCLUSION

After examining the impact of human capital on economic growth and obtaining the results of the estimation, we conclude a set of points that can be summarized as follows:

- In the short term, we find that the only variable that affects economic growth is physical capital, as the increase in physical capital in the current year leads to an increase in economic growth in the following year;
- Also, in the short term we note the lack of influence of human capital on economic growth.
- Both physical capital and Labor have a positive (direct) relationship with economic growth through positive values for the parameters of these variables and the statistical significance of these coefficients at the level of significance 1%;
- Physical capital in the long term affects positively the economic growth, and this means that increasing the volume of material capital that Algeria possesses machines, equipment, means of production and others contributes to increasing economic growth, and therefore it positively affects the economic growth in Algeria and this is compatible witheconomic theory;
- Labor in the long term affects positively economic growth and this means that an increase in the size of labor (the size of employment) leads to an increase in the volume of production within institutions, which leads to an increase in economic growth in Algeria, and therefore labor has a positive impact on economic growth, this is also compatible with economic theory;
- Human capital in the long term, although it has statistically significant at the level of 1%, but it has a negative (inverse) impact on economic growth through the negative value of his coefficient;
- Human capital in the long term negatively affects economic growth and this is contrary to many previous studies results. However, the negative impact of human capital on economic growth in Algeria is due, in our view, to a set of reasons, which we summarize briefly as follows:

- The fact that increased spending on investment in human capital (especially spending on the three ministries: national education; higher education and scientific research; training and vocational education) has led to an increase in the amount of human capital (an increase in the number of people enrolled in both secondary and university education, vocational training) on the one hand, but the fact that this volume of human capital did not contribute to increasing the economic growth made it a burden on the Algerian economy and made it as costs do not achieve the desired returns from it on the other hand;

- Focusing on the quantitative aspect only for the process of investing in human capital led to an increase in the number of successful students in the baccalaureate each year, and also contributed to the increase in the number of registered in higher education, and the creating of the new system of LMD led to reduce the duration of education and increase the number of graduated students, and accordingly the number of educational institutions and university institutions increased, but it did not improve Algeria's rank in terms of quality of education or in terms of scientific production, nor did it lead to an increase in the number of patents, nor did it lead to graduating the worker's hand qualified enough for the requirements of the labor market in Algeria;
- Large volume of spending directed to investing in human capital was focusing on the nominal elements rather than focusing on the basic elements of the investment process. Where much of the expenses were directed to building school and university restaurants, building university residencies and providing transportation, food and accommodation services, as well as transferring a grant to those in need and the provision of textbooks, and so on. The aim was to provide all these services free of charge, which led to a rise in corruption and looting of public money under the cover of these services, after all this Algeria did no achieved the real goal of investing in human capital;
- The lack of significant employment opportunities for secondary school level and for university graduates and for vocational training graduates, which made them suffer from unemployment and this was a lost opportunity for Algerian economy of an educated and youthful labor force;
- Most of the employment opportunities that were achieved for graduates were either within the framework of vocational integration contracts or they were more job opportunities in the management sector than in other sectors, which does not contribute to creating added value to increase economic growth but rather makes human capital in the context of persuasive unemployment, this leads to a loss of the amount of knowledge and skills that individuals have gained from education and training and their entry into unproductive routine work, which makes investment in human capital that Algeria makes in the form of a burden or costs borne by the state without achieving substantial returns from it.
- Human capital in Algeria does not contribute to achieving sufficient added value because human capital is not relied upon as one of the most important determinants of economic growth in Algeria. We find that the

Algerian economy is not based on the knowledge economy but rather is mainly based on the revenues of the hydrocarbon sector;

- The results shows that human capital had no impact on economic growth in the short term, while had achieving it in the long term and this result was also reached by study of (Reza &Valeecha, 2012);
- As for the inverse relationship between human capital and economic growth in Algeria during the period 1970-2018, it is similar to the conclusion reached by: (Afzal, Shahid, Hafiz, Begum, & Quddus, 2010)study, and (Moussaoui, Investing in human capital and its effect on economic growth, the case of Algeria 1970_2011 (PhD thesis En Arabic), 2015).

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